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University of Nevada
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MUHLENBERGIA

STUDIES IN TRIFOLIUM—VII

By P. Beveridge Kennedy

Some time has elapsed since our last paper of this series was published in Muhlenbergia. Since then we have had the privilege of studying for several months at the herbarium of the Royal Botanic Gardens, Kew, London, while on sabbatical leave from the University of Nevada. Our attention in the herbarium was given exclusively to the clovers, and copious notes were taken from the types of American species.

The publication of Miss L. F. McDermott's book entitled "North American Trifoliums," under the supervision of Professor Jepson, of the University of California, led us to believe that a satisfactory treatment of the genus could not be made by a study of herbarium specimens alone, but that the different species would have to be watched from the seed to maturity. This feature of the work is now in progress both in the field and greenhouse, and a number of new and interesting observations have been made.

Drawings of each species have been made under our direct supervision by Mr. L. T. Shannon, a student in the University. They are very complete and accurate, and consist of a drawing of the entire plant; a seedling; the variations in the shape of the leaflets within the species; a floret in full bloom; a floret just after blooming; the calyx tube and teeth spread out; the vexillum; the legume and the seed These illustrations will not be used until the monograph is completed for publication.

Our present paper includes a general discussion of the Macraei group, a correction of the errors of previous workers on Trifolium, complete descriptions, which in many cases were so

meagre that it was almost impossible to identify the species, and the addition of three new species to the group. The work is being carried on as a project under the Adams fund of the Nevada Agricultural Experiment Station.

Corollas

The vexillum or standard in this group has the free tenth stamen attached to or with it at the base, the filament joining with the main central vein. It is never attached for more than 2 millimeters. The lower lateral margins of the vexillum are curved inward to a greater or less extent, varying with the species. At the lower central portion a depression from within outward takes place, forming a sort of pouch. This is variable in the different species, increasing with the age of the flower. It is probably caused by the swelling up of the ovary to form the legume.

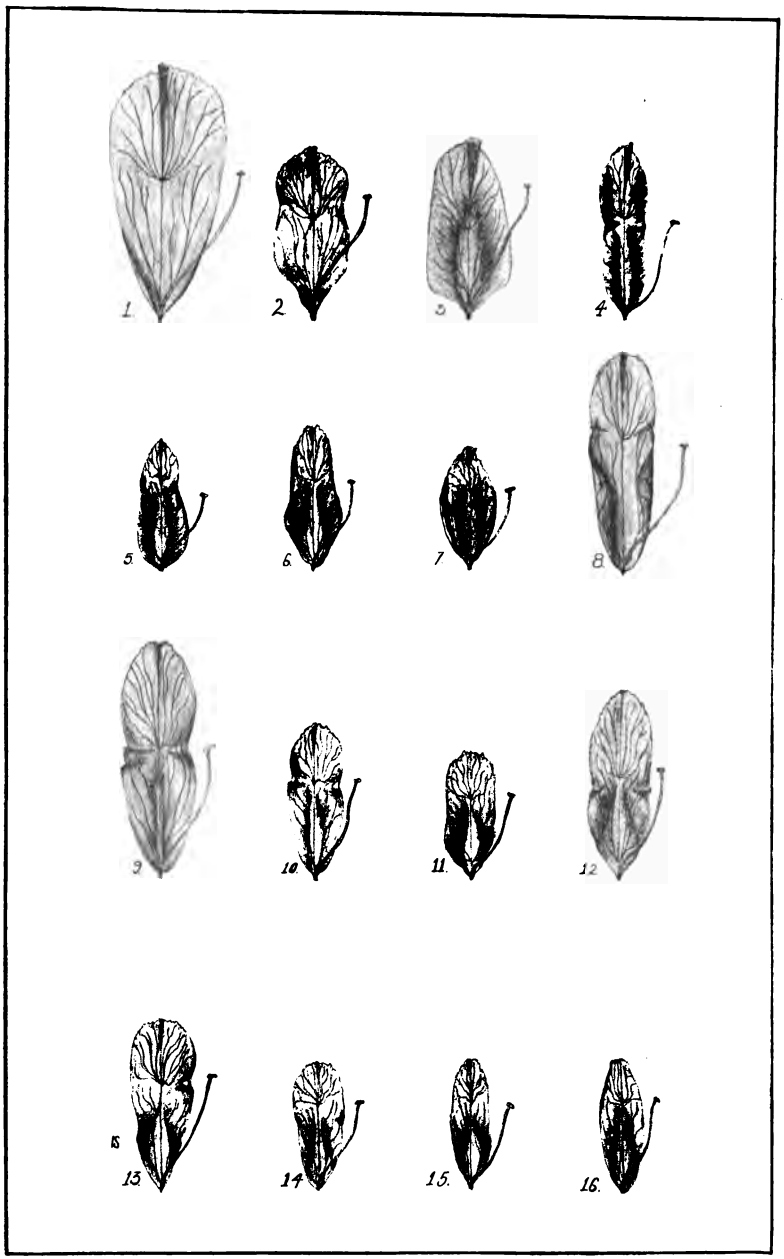
The filaments of the remaining nine stamens are joined together for about three-fourths of their length to form a tube open down one side. The claws of the wings and keel are so closely associated with this stamen tube on its outer surface that it is difficult to determine whether they are actually joined with the tube or not. In both boiled dried specimens and fresh flowers, the claws have to be forcibly removed from the back of the stamen tube. The free portion of the filaments are conspicuously dilated near their junction with the anthers. The style also is dilated towards its upper half. These observations refer only to this group of the genus.

Pollination

Although there is an abundance of literature on the pollination of clovers, particularly the European species commonly used as forage crops, very little can be found treating of the native American species.

We have been able to produce seed abundantly from this group of clovers without the aid of insects. In the laboratory in the dead of winter, without even a fly about, the different species set seed freely. This experiment was repeated numerous times in the greenhouse with the same result. We are inclined

PLATE 1



VEXILLUMS

1 amoenum. 2 dichotomum. 3 neolagopus. 4 olivaceum. 5 columbinum. 6 insularum. 7 Helleri. 8 petrophilum. 9 californicum. 10 Macraei. 11 catalinae. 12 Traskae. 13 mercedense. 14 bicephalum. 15 albopurpureum. 16 pseudo-albopurpureum.

to doubt whether the visits of insects could increase the production of seed in this group. On the other hand, an exceedingly robust plant of the European *Trifolium pannonicum*, the Hungarian clover, failed to produce a single seed under like conditions.

We expect to be able to show great differences in the various groups of clovers in the manner of pollination and the production of seed. Some groups other than this one also produce seed abundantly without the aid of insects. That the seed produced by self fertilization is good there can be no doubt, as in some instances the flower heads have touched moist sand and the seeds have germinated while still inclosed in the pods and attached to the living plant.

With most of the native perennial clovers, however, insects seem to be necessary. This feature will be taken up as each group is treated, so for the present we desire to report conclusively only upon the American species of this group.

Seeds

The seeds of the different species of American clovers have been almost entirely neglected in the descriptions. We have reviewed the hundred or more descriptions, and find the seed rarely mentioned, the description usually ending with the number of seeds in the legume. The more recent literature seems to err to a greater extent in this particular than the earlier. The most complete description of the seed of a Trifolium that we have found is in connection with the Mexican species, *T. amabile* H. B. K. in Kunth, Nova Genera and Species Plantarum **6**: 503. *pl. 593*. It is as follows; "*Semina* (fig. 16-18) podospermis brevissimus suspensa, subrotunda, compressiuscula laevia, fusca, glabra, opaca, magnitudine grani majoris papaveris vel (in leguminibus monospermis) duplo majora, hilo parvo marginali et sub hoc macula oblonga costanea notata. Integumentum simplex, membranaceum, interne endospermio tenui gelatinoso hyalino vestitum. *Embryo* (fig. 19 20) uncinatus lutescens. *Cotyledones* ellipticae plano-convexae, aequales. *Radicula* in extremite apicem leguminis spectante sita, intus curvata et hilum spectans, teres, acutiuscula, cotyledonibus brev-

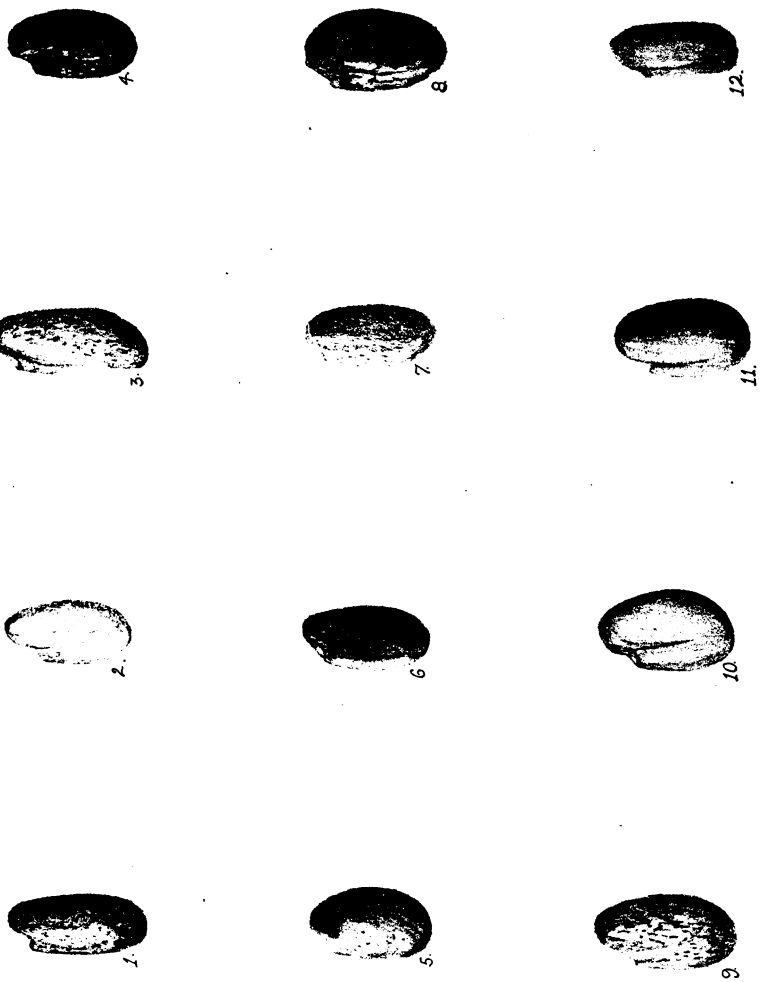
ior." While this is perhaps going to the extreme in describing a seed in connection with a description of a species, and in a work not devoted to seeds, yet it is much to be preferred to descriptions where the seed is not even mentioned.

When one finds differences in the seeds of two troublesome closely related plants, he can usually conclude that they are different species. In the present group we have been greatly aided in having an abundance of seed of a number of the species. First recognizing a difference in the seed, we have worked backwards and found other specific characters.

In Landwirtschaftliche Samenkunde 621-630, by Dr. C. D. Harz, a work devoted entirely to seeds, we find the seeds of 13 species of the most useful European clovers described, with many morphological and histological illustrations. In North American Trifoliums 200, by McDermott, section *Macraeae*, we find "seedf obcordate." We have found no obcordate seeds in this group, as we understand the term.

The seeds of this group, represented in plate 1, are more evenly symmetrical in outline than in most of the other groups. They are oval, ovoid, elliptical or oblong, with the hilum near the upper end of the seeds. We have found only one mature seed in a legume of any of the species, but there are frequently two ovules. If one takes individual seeds it will be difficult to recognize much difference in the color of the seeds of the various species, but by placing them in a bottle and looking at a mass of them, the coloring is quite distinct. There may be dark and light seeds, with some heavily mottled and others less so, but when placed together the distinct shade is quite discernable to anyone even quite unfamiliar with seeds or plants. It is our intention to show these seeds in colors in the monograph. In size they average about 2.2 mm. long and 1.2 mm. wide.

PLATE 2



Explanation of Plate 2

1. *T. dichotomum* H. & A. Seeds light brown, 2.3mm. long, elliptical, mottled, but sometimes only faintly so.

2. *T. amoenum* Greene. Seeds very light yellow, ovoid, not mottled, 2.5 mm. long, 1.5 mm. wide.

3. *T. petrophilum* Heller. Seeds light brown, faint markings at one end, 2.7 mm. long, 1.2 mm. wide.

4. *T. neolagopus* Loja. Seeds olive green to yellowish, oval, irregularly mottled with dark purple markings, shiny, 2.1 mm. long, 1.2 mm. wide.

5. *T. olivaceum* Greene. Seeds light yellowish-brown with a few faint markings, oval, 2 mm. long, 1 mm. wide.

6. *T. columbinum* Greene. Seeds large, brown, no markings, broadly ovoid, 3 mm. long, 1.6 mm. wide.

7. *T. albopurpureum* T. & G. Seeds very light brown, sometimes faintly mottled, small, 2 mm. long, 1.1 mm. wide, elliptical.

8. *T. Helleri* Kennedy. Seeds brown, densely covered with deep purple or reddish-brown markings, elliptical, 2 mm. long, 1 mm. wide.

9. *T. Macraei* H. & A. Seeds brownish-yellow, strongly marked with deep purple, ovoid, 2 mm. long, 1.1 mm. wide.

10. *T. catalinae* Wats. Seeds yellowish-green, 1.8 mm. long, ovoid, devoid of markings.

11. *T. mercedense* Kennedy. Seeds light brown, ovoid, 2 mm. long, devoid of markings.

12. *T. insularum* Kennedy. Seeds dark brown, not mottled, narrowly oblong, 2 mm. long.

Seedlings

We have been unable to find any literature dealing with the seedlings of the different species of American clovers. In "Memoires sur la famille des Legumineuses" by M. Aug. Pyr. De Candolle, a most excellent work, several hundred genera of Leguminosae are discussed, with numerous illustrations of the seedlings. Strange to say, an important genus like Trifolium

is omitted, although Lathyrus, Lupinus, Medicago and Pisum, also common and important genera, are well illustrated. In the text on page 77 we find Medicago and Trigonella mentioned and a reference to the figures. The seedlings of *Medicago sativa*, *pl. 7. f. 15.* does not resemble a seedling grown from ordinary commercial alfalfa seed of the present day, which is supposed to be *Medicago sativa.* Under Trifolium we have only the word "idem," referring to it as the same as Trigonella and Medicago, but without a figure of any species of Trifolium.

The first leaf of most of the species of American clovers resembles Medicago. The group illustrated here may be considered typical, but other groups vary considerably from these. Although the genus Trifolium has always been considered to have the first leaf simple, we have found that in one of the gronps to be discussed in a later paper, the first leaf is distinctly trifoliolate. This last observation is interesting, as it was evidently not observed by De Candolle, since he states the following on pages 88 and 89: "Les Trifles, dont j'ai observe 'une dizaine appartenant 'a toutes les sections du genre, ne different point des Trigonelles et des Melilots par les caracteres generaux."

The cotyledons in all the groups of clovers that we have studied are very similar. They are somewhat fleshy and glabrous, and generally oblong or elliptical in outline. The margins are entire. The difference is chiefly in the size, the length of the petiole, and the manner in which it is attached to the lamina.

The plate here shown is prepared especially to show that *T. amoenum* and *T. dichotomum* are distinct species. *T. amoenum, f. 1.* is densely hairy on both surfaces of the first leaf and has a broad notch at the apex, while *T. dichotomum* is glabrous on both surfaces and slightly emarginate.

The drawings will also show that there is a good specific character in the first leaf. The trifoliolate leaves which develop later vary to a very great extent in shape and margination, but the character of the primordial leaf is constant. Occasionally we have found a monstrosity in a seedling having three cotyledons

In Seedlings **1**: 418. by Sir John Lubbock, there is a figure of a seedling of an European species of clover, *Trifolium Boissieri* Guss. This is evidently a yellow flowered species which should be placed in the genus Chrysaspis, a segregate from Trifolium, as proposed by Dr. Greene. The drawing represents the first leaf as coming out from the main stem at some distance from the cotyledons, unlike any of the American clovers. The long pedicel to the central leaflet of the trifoliolate leaves is also shown, which is characteristic of some of the species of Chrysaspis.

The genus Trifolium is mentioned in a recent publication entitled "An investigation of the seedling Structure in the Leguminosae," by Robert Harold Compton, Journ. Linn. Soc. (Botany) **41**: 1-122. *pls. 9*. The investigations were carried on at the Botany School, University of Cambridge, England, and show a large amount of painstaking and thorough work on the anatomical and histological characters of the seedlings of Leguminosae, with a review in tabulated form of all previous literature. Plate 1 shows photographs of the external character, such as the root, the cotyledons and the first leaf, or sometimes a few of the succeeding ones, of seventeen different seedlings. The remaining eight plates represent numerous drawings from histological sections, showing the fibrovascular system of about forty species from all sections of the family. The only illustration which concerns our present work with the Leguminosae is that of *Trifolium arvense*, an European clover, but naturalized as a weed in America in many places. The seedling is very similar to those belonging to the group here treated, as shown in our plate 2. It is very probable that *T. arvense* and its European relatives are closely allied to this group of American Trifoliums.

Explanation of Plate 3

1. *T. amoenum* Greene. Cotyledons 6.5mm. long by 3mm. wide; primordial leaf 5 mm. long, 4 mm. wide, petiole and both surfaces long pubescent, lateral margins entire, broadly retuse at apex.

2. *T. dichotomum* H. & A. Cotyledons 7mm. long, 3mm. wide; primordial leaf 4.5 mm. long, 5 mm. wide, glabrous on both surfaces, margins undulate-dentate, apex retuse, petiole sparsely pubescent.

3. *T. petrophilum* Heller. Cotyledons 7 mm. long, 3 mm. wide; primordial leaf 4.5 mm. long, 4 mm. wide, both surfaces pubescent, margins remotely undulate-dentate, apex truncate, mucronate, petiole pubescent.

4. *T. neolagopus* Loja. Cotyledons 7 mm. long, 2 mm. wide; primordial leaf 3 mm. long, 4.5 mm. wide, upper surface pubescent, lower glabrous, margins slightly undulate, apex broadly obtuse, mucronate, petiole pubescent.

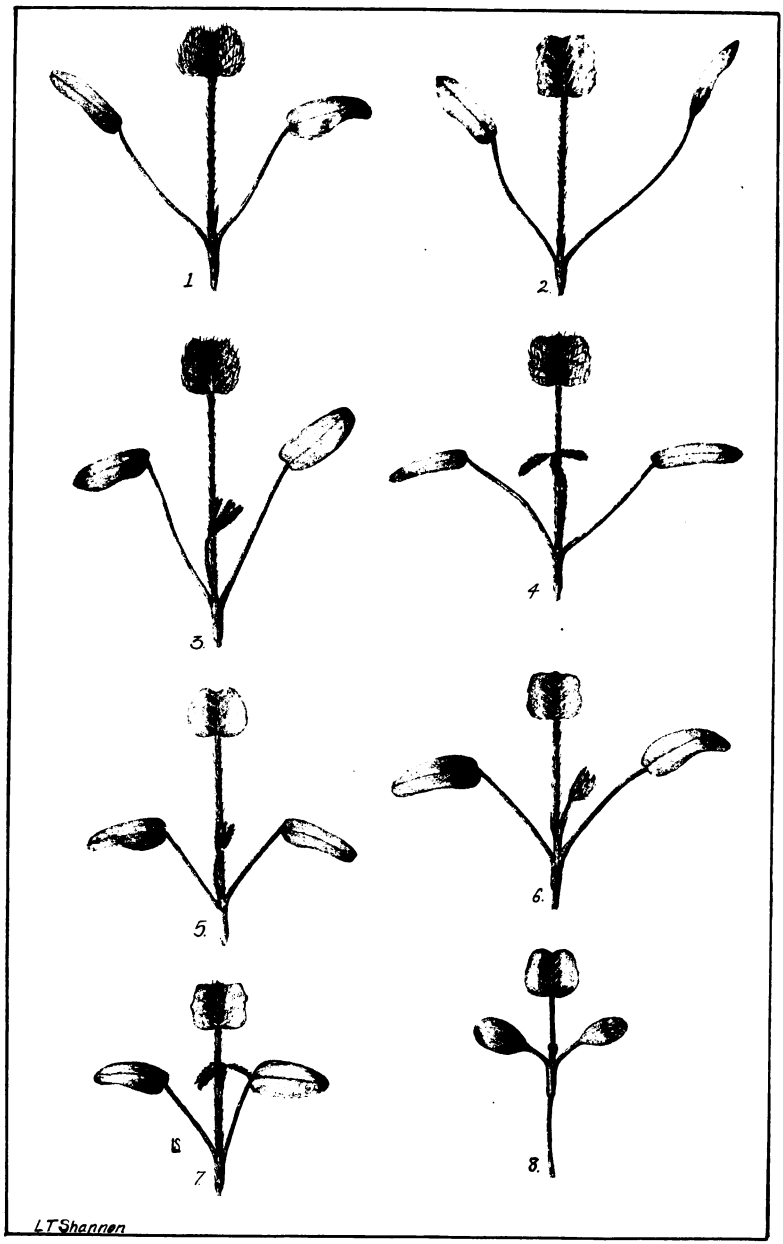
5. *T. olivaceum* Greene. Cotyledons 6 mm. long, 3 mm. wide; primordial leaf 3 mm. long, 4.5 mm. wide, glabrous on both surfaces, margins entire, apex emarginate, petiole pubescent.

6. *T. albopurpureum* T. & G. Cotyledons 7 mm. long, 2 mm. wide; primordial leaf 3 mm. long, 4 mm. wide, glabrous on both surfaces, apex truncate, mucronate, petiole pubescent, margins slightly undulate.

7. *T. Helleri* Kennedy. Cotyledons 6 mm. long, 2.5 mm. wide; primordial leaf 3 mm. long, 4 mm. wide, a few hairs on the upper surface, apex truncate, mucronate, petiole sparsely pubescent.

8. *T. mercedense* Kennedy. Cotyledons very small, 4mm. long, 2 mm. wide, the petiole decurrent with blade; primordial leaf 3.5 mm. long, 4 mm. wide, apex emarginate, all parts glabrous, or an occasional hair on the petiole.

PLATE 3



SEEDLINGS

KEY TO THE SPECIES

Corolla conspicuous and showy, extending well beyond the calyx teeth at maturity
- Stems medium, heads ovate-conical, corolla extending 2.5 mm. beyond calyx teeth; teeth pubescent; vexillum 12 mm. long; legume glabrous: seeds light brown — T. dichotomum
- Stems very stout; heads semi-globose; corolla extending 4 mm. beyond calyx teeth; teeth densely plumose; vexillum 14 mm. long; legume hairy at apex: seeds very light yellow — T. amoenum
- Stems slender; heads elliptical; corolla extending 3 mm. beyond the calyx teeth; teeth villous; legume glabrous; seeds brown — T. californicum

Corolla not showy, but extending slightly beyond the calyx teeth at maturity
- Heads sessile or very short peduncled; inflorescence usually 2-headed
  - Stems slender and decumbent — T. Macraei
  - Stems stout and erect — T. mercedense
  - Stems short and rigid — T. catalinae
- Heads with peduncles 2 cm. or more long
  - Calyx teeth 6 mm. long; leaflets silver-gray — T. petrophilum
  - Calyx teeth 4.5 mm. long; leaflets narrow and acute at both ends — T. Traskae
  - Calyx teeth 2 mm. long: leaflets oblanceolate — T. pseudo-albopurpureum

Corolla inconspicuous, about the length of the calyx teeth
- Calyx tube 2 mm. long; leaf margins entire or remotely dentate — T. albopurpureum
- Calyx tube very short, 1 mm. long; nerves very prominent: leaf margins serrulate — T. neolagopus
- Calyx tube short, 1.2 mm. long; leaf margins irregularly and prominently serrulate-dentate — T. Helleri

Corolla concealed, shorter than the calyx teeth
- Calyx tube 1 mm. long, teeth 7 mm. long; vexillum acute, half the length of the teeth — T. columbinum
- Calyx tube 2 mm. long, teeth 9 to 10 mm. long; vexillum obtuse, half the length of the teeth — T. olivaceum
- Calyx tube 2 mm. long, rigid; vexillum emarginate, three-fourths the length of the teeth — T. insularum

TRIFOLIUM DICHOTOMUM H. & A.

An erect, somewhat spreading plant about a foot high, with conspicuous dark purple flowers in ovate-conical heads. The leaves are obovate to oblanceolate and covered with white hairs.

The flower heads are at first turbinate, with the center green and undeveloped, the outside and lowermost florets only in bloom. As the center increases and develops, the head elongates in growth. The lowest series of florets have started to fade

by the time the second and third series are in bloom. In this manner the head is in flower for a considerable time (three weeks). The shape of the head therefore varies according to the stage of growth, a fully developed head with all the flowers matured and faded being distinctly conical.

Annual, 4 dm. high, more or less branched, erect, somewhat rigid, pilose throughout: leaflets obovate to oblanceolate on short petioles, coarsely dentate, about 25 mm. long, 12 mm. wide, the lower leaves few on rather long petioles of about 4 cm., leaflets smaller, cuneate, emarginate, dentate; stipules broadly and shortly ovate-acuminate, mostly entire, nerved: mature peduncles 8 to 10 cm. long: heads about 22 mm. long, 17 mm. wide, ovate-conical, villous: calyx tube obconical, about 3 mm. long, prominently 20-nerved, teeth 7 mm. long: corolla extending about 2.5 mm. beyond the calyx teeth (in fruit twisted and shrunken and often appearing as if shorter than the calyx teeth); vexillum obovate-lanceolate, with a small mucron and minute irregular dentations at apex, 12 mm. long, 4 mm. wide, purple at base, shading to white; wings and keel purple and white: ovary 2.5mm. long, one ovuled: style 5mm. long: legume 4mm. long, 1.5mm. wide, one seeded, glabrous, striate, elliptical, membranaceous: seeds light brown, 2.3 mm. long, elliptical, mottled, but sometimes only faintly so.

The following specimens from California have been examined:

Contra Costa county: Antioch, *Mrs. Brandegee*, May, 1907 (compared at Kew with the type and found to be typical); hills three miles south of Antioch, *Heller 8903;* Antioch, *Davy 949;* Byron, *Baker 2797;* cultivated at Reno from Antioch seed, *Kennedy*, 1910.

Alameda county: Between Mission San Jose and Livermore, *Heller 7316.*

A series of sheets from the north do not conform exactly to the type, all having smaller leaves and heads, and less conspicuous flowers. When better known in the field this northern form may show specific differences. The specimens are as follows:

Oregon: Near Nustucker river, *R. W. Summers*, 1876;

Silverton, *Howell*, June, 1882; prairies, Douglas county, *Howell*, April 28, 1891; no locality, *E. Hall 95*, 1871.

Washington: Bingen, *Suksdorf 4508*.

Vancouver Island: Oak Bay, *Macoun 78923*.

TRIFOLIUM AMOENUM Greene

An exceedingly handsome, stout stemmed annual with large broadly obovate leaflets, globose heads, and a very showy corolla. The calyx is densely plumose. Collected in Solano county, California.

Annual, simple or branched from the base, about 8 dm high, canescently villous throughout: stems stout, rigid, striate, internodes long: basal leaves few, small, on long petioles, soon disappearing; others very large, broadly obovate to obovate-lanceolate, 3.5 mm. long, 2 cm. wide, obtuse, sometimes mucronate, remotely or strongly erose dentate; petioles from 7 cm long to about 1 cm. or less at base of peduncles; stipules lanceolate below to broadly ovate above, with a prominent triangular acumination about 1 cm. long, lobes more or less notched, prominent veins beneath the pubescence: heads 1 to 3 on each branch, terminal or subterminal, globose when young, ovate with age, very large, 3.5 cm. long, 3 cm. wide: peduncles from 1 to 10 cm. long on the same plant, increasing with age: flowers showy, corolla with deep purple spot and extending beyond the calyx teeth 4 mm.: calyx tube 3 mm. long, teeth 8 mm, long, both densely plumose: vexillum oblanceolate, 13mm. long, 4mm. wide: ovary 2 mm. long, pubescent at apex, 2-ovuled; style 8 mm. long: legume membranaceous, elliptical, striate, light straw colored, pubescent at apex only, 4 mm. long, 2 mm. wide, 1-seeded: seeds decidedly yellow, ovoid, devoid of markings, 2.5 mm. long, 1.5 mm. wide.

This is by far the largest and handsomest species of the group. In North American Trifoliums 219, and in Flora of Western Middle California, ed. 2, 227, it has been placed as a synonym of *T. dichotomum* on the authority of Dr. Jepson, who is said to have compared it with the type of *T. dichotomum* at Kew. My observations at Kew led me to an entirely different

conclusion. The species are abundantly distinct. *T. dichotomum* was named from specimens collected by Douglas in California in 1833. There are two sheets, one in Hooker's herbarium, the other in Bentham's. The type specimen on Hooker's sheet is a large one, and corresponds very closely with those from Antioch, Contra Costa county collected by Mrs. Brandegee, Davy and myself. In the original description of *T. dichotomum* the statement "the calyx quite as long or rather longer than the corolla," is not quite true even in the type, although it appears so in mass, and more so on account of the dried up condition of the corolla.

It is unfortunate that Miss McDermott should have had so good a species as *amoenum* illustrated under the name of *dichotomum*. If one has nothing but the seeds of the two species they could readily see the great difference between them. We have been fortunate enough to secure a large quantity of seed of *amoenum* from the type locality, and have grown it successfully under cultivation.

I was interested in finding a specimen of *T. amoenum* at Kew, collected by Lobb in California, with the number 270. From the account by Miss Eastwood in Muhlenbergia 7: 20, of Lobb's explorations, we should gather that the plant was collected some time between 1850 and 1860. The sheet remained in the herbarium without a name until Dr. Greene discovered it and placed on it in pencil *T. amoenum*. It was evidently not recognized as *T. dichotomum*. The following differences may be found between *amoenum* and *dichotomum*:

amoenum	*dichotomum*
Seeds light yellow, devoid of markings, ovoid.	Seeds light brown, smaller, faintly mottled, elliptical.
Corolla very large, extending 4mm. beyond the calyx teeth.	Corolla smaller, extending 2.5 mm. beyond the calyx teeth.
Legume very hairy at apex.	Legume glabrous, narrow, acuminate at apex.
Calyx teeth covered very densely with soft plumose hairs	Calyx teeth covered with straight hairs.

amoenum	*dichotomum*
Leaves very large, orbicular-obovate.	Leaves smaller, obovate-lanceolate.
Heads semi-globose even in fruit.	Heads ovate-conical in fruit.
Stems very stout	Stems medium.
First leaf hairy on both surfaces, with a broad notch at apex.	First leaf glabrous on both surfaces and very slightly emarginate.

The following are typical sheets of *amoenum:*

Solano county: Vanden station: *Greene, Heller and Brown 5593;* Elmira, *Baker 2901.*

California, *Lobb 270;* cultivated at Berkeley, *Greene*, 1892; cultivated at Reno, 1910, from Elmira seed, *Kennedy.*

Cultivated in the field in this climate the leaves become much smaller, as would be expected on account of the dry atmosphere.

TRIFOLIUM CALIFORNICUM Jepson

T. dichotomum var. *turbinatum* Jepson

T. californicum forma *turbinatum* (Jepson) McDermott

A much branched annual about a foot high, more or less villous pubescent throughout, with elongated heads and showy, conspicuous flowers. Corolla deep purple, tipped with cream.

Annual, stems numerous from the base rather slender, dichotomously branched above, more or less pubescent throughout, internodes 4 to 6 cm. long: lower leaflets obovate-cuneate to elliptic-oblanceolate, dentate, about 1 cm. long, petioles 2 to 5 cm. long; upper leaflets larger, about 1.5 cm. long, narrower and with shorter petioles; stipules small, lobes broadly ovate, abruptly acuminate: heads ovate when young but becoming distinctly spicate and much longer with age, about 2 cm long: peduncles unusually long, subterminal about 4cm. long, the terminal elongating to 12 to 16 cm. after anthesis: flowers showy, flowering from the base upwards; corolla during anthesis extending 3 mm. beyond the calyx teeth, afterwards elongating to about twice their length; vexillum, wings and keel deep purple, tipped with creamy white, fading to purple with age: calyx tube

2 mm. long, teeth 3.5 mm., villous: vexillum 9 mm. long, 5 mm. wide: ovary 2-ovuled: style 6 mm. long: legume glabrous, one-seeded, membranaceous, faintly striate, elliptical, 3 mm. long: seeds brown, 2.3 mm. long, elliptical, without markings.

This species differs from *dichotomum* in having a very conspicuous purple corolla tipped with white. The florets are conspicuous from the beginning, in which they are unlike any other species of the group. The type collection of var. *turbinatum* Jepson, Ross valley, *Jepson*, May 8, 1894, which is a small and young *californicum* shows this character very strikingly. The heads are at first turbinate and later become elliptical or conical. In the original description in Flora of Middle Western California, where it is called *T. dichotomum*, the statement calyx teeth "nearly or quite as long as the corolla" is very misleading, as the plants all have the corolla considerably longer than the teeth, both when young and old. Specimens considered typical, from Conn valley, Napa river basin, *Jepson*, have the corrolla considerably longer than the calyx teeth.

It seems to be confined to the hills along the Coast Range, growing in patches in both cultivated and uncultivated areas. The following sheets represent the different forms of growth from small plants with few branches to large plants profusely branched from the base:

Santa Clara county: Mt. Hamilton, *Elmer 2202, 4931;* Los Gatos, *Kennedy*, May, 1907, *Heller 7423.*

Sonoma county: Near Mark West Springs, *Heller and Brown 5290.*

Marin county: Ross valley, *Michener and Bioletti 20.*

TRIFOLIUM MACRAEI H. & A. (Plate 5.)

T. bicephalum Elmer

A low pubescent annual, simple or branched from the base with decumbent spreading or suberect stems, and usually a pair of sessile or subsessile heads subtended by short petioled leaves and one or more very broad stipules. The type plants were collected by Macrae at the Baths of Collina, Chili, in 1825. Other collections are, sandy hills, Valparaiso, *Mathews 174;* Valpa-

PLATE 4

Type of T. albopurpureum T. & G. Type of T. dichotomum H. & A. (lower left hand corner.)

raiso, *Cuming 749;* near Valparaiso, *Cuming 750;* Santiago, *Phillipi 651;* Conception, *Germain*, 1856 and 1857.

The plants which come nearest to these in the United States are from the vicinity of Pacific Grove, Monterey county, California, and it is from these that the description is taken.

Annual, about 1 dm. high, simple or with few to many stems from the base, suberect or spreading, clothed throughout with a dense white pubescence: lowest leaves on petioles about 20 mm. long, with obovate-cuneate emarginate, dentate leaflets; cauline leaves more inclined to be larger and elliptical; lower stipules narrow, with a long acumination, becoming broader and shorter towards the summit of the stems: heads in young plants appearing among the leaves, but later elongating so as to exceed them, semiglobose, not conical, in pairs, though in young plants obscurely so, sessile or subsessile, subtended by broad stipules and short petioled, usually narrow leaves: uppermost internodes usually very long, two or three times the length of the lower ones: flowers when young short and concealed by the calyx teeth, later developing so as to slightly extend beyond them: calyx tube and teeth of nearly equal length, tube 2 mm., teeth 3 mm., both densely covered with a soft pubescence: vexillum elliptical, 6 mm. long, 2 mm. wide, purple, tipped with white, or in some specimens all creamy or dull colored: ovary 2-ovuled: style 3 mm. long: legume large for the size of the flower, oval, 3 mm. long, slightly hairy at apex, 1-seeded: seeds 2 mm. long, ovoid, brownish-yellow, strongly marked with deep purple.

The following collections are considered under *Macraei:*

Monterey county: Pacific Grove, *Kennedy*, May, 1907; between Point Pinos and Pacific Grove, *Heller 6744;* Del Monte, *Heller 6664.*

San Mateo county: San Pedro, *Elmer 4812* (type number of *T. bicephalum* Elmer).

Santa Clara county; Mt. Hamilton, *Elmer 4673.*

San Francisco county: Presidio, *Heller*, June 17, 1902; without locality, *Michener and Bioletti*, April, 1892.

An examination of the type sheet of *T. Macraei* (see plate 5) in Hooker's herbarium at Kew shows that the sheet must

have been added to at different times as specimens came in. There are four plants or parts of plants on the upper middle half of the sheet. One of them is not a clover at all, and the other three are simple stemmed *Macraei*. Directly below are three plants which look exactly the same. The accompanying label in the middle reads "Baths of Collina, Macrae." These plants all have sessile heads subtended by broad stipules. There are two sets of leaves, sessile or almost sessile, which are inserted with the head. The leaflets, which are decidedly acute and serrate, extend beyond the head several millimeters.

Two small plants on the upper left hand corner of the sheet are from sandy hills, Valparaiso, *Mathews 174*. These represent the very low form with several decumbent stems and very small sessile heads. This collection is cited in the original description.

On each side of the sheet below are pedunculated headed specimens from California. These are very likely Douglas' collection of 1833, and are good *albopurpureum*. They are labeled "T. Macraei H. & Arn. in B. Misc." and underneath "T. albopurpureum Hook. and Arn."

Another citation in the original description is Valparaiso, *Cuming 749*. These specimens are much branched with some short pedunculate heads, one single, but mostly in pairs. In one the peduncle is 15 mm. long, while in another, one of the heads is sessile and the other with a peduncle 5 mm. long.

Elmer, at the end of his original description of *T. bicephalum*, Bot. Gaz. **41**: 312. 1906, says: "This species comes nearest to the so-called *T. Macraei* H. & A., but it is a much smaller and more prostrate clover with leaves distinctly obovate and emarginate." But this is exactly the character of the true *Macraei* from Chili, and the type number of *bicephalum* seems to correspond very closely. If, however, the South American plant can be shown to be different, then the low sessile two-headed plants of Pacific Grove and vicinity are *T. bicephalum*.

Trifolium mercedense sp. nov.

A densely pubescent large double-headed relative of *T. Macraei* about a f ot high, with erect stout stems from the base. The leaves subtending the heads and stipules are very long and narrow, the flowers larger and the calyx teeth twice or more times the length of the tube. The sheet taken as the type, in the herbarium of the Missouri Botanical Garden, was collected at Lake Merced, San Francisco, California, April 23, 1903, *J. P. Tracy 1822.* Similar plants are San Bruno hills, San Mateo county, *Elmer 4713*, and *C. P. Smith 1420;* Lake Pilarcitos, San Mateo county, and Lake Earle, Del Norte county, *Davy.*

Annual, 2 to 3 dm. high, more or less branched from the base, densely pubescent throughout, stems terminating in a double-headed inflorescence subtended by large ovate stipules and long narrow leaflets: lowest leaflets orbiculate-obovate to cuneate-emarginate, remotely dentate, about 12 mm. long, 8mm. wide; upper leaflets larger and narrower, broadly elliptical to oblanceolate, 15 mm. long, coarsely dentate towards the apex; pedicels about 4 cm. long; stipules narrow below to broadly ovate above, prominently veined, lobes of lower stipules with a long acumination 5 mm. long, uppermost stipules broad, the undulate margins terminating in an abrupt triangular point: heads sessile or with a peduncle 3 or 4 mm. long, large, ovate, 15 mm. long and almost as wide: calyx tube 2 mm. long, teeth 5 mm. long: corolla extending 1 to 2 mm. beyond the teeth; vexillum elliptical, 8 mm. long, 2.6 mm. wide, very minutely erose-dentate at apex: ovary 2-ovuled: legume 3 mm. long, 1.5 mm. wide, hairy at apex, 1-seeded: seeds ovoid, light brown (larger than *Macraei*), 2 mm. long, devoid of markings.

TRIFOLIUM CATALINAE Wats.

T. Macraei forma *catalinae* McDermott

A very low branching annual, with sessile heads subtended by broad ovate-acuminate stipules and trifoliolate leaves with very narrow leaflets. Collected only on Santa Catalina island, California, by Brandegee, Trask, Fritchey and Grant.

Low annual, branching from the base, 1 dm. high or less, appressed villous pubescent: leaflets narrowly oblong-obovate, 7 mm. long, 2.5mm. wide, emarginate, erose-dentate; subtending stipule broadly ovate-acuminate, entire or with an occasional notch near the apex; lower stipules much narrower and with a long aristate point 2.5mm. long: heads sessile, one or two, orbicular-ovate, subtended by a stipule and almost sessile leaf: flowers dark purple: calyx tube 2 mm. long, strongly 10-nerved, teeth 3 mm. long, erect, somewhat rigid: corolla little exceeding the calyx teeth; vexillum 6 mm. long, 1.3 mm. wide, elliptical, minutely erose dentate at apex: legume glabrous, straw-colored, striate, acute at both ends, 3 mm. long, 1.5 mm. wide, 1-seeded: seeds yellowish-green, devoid of markings, ovoid, 1.8 mm. long.

Miss McDermott cites a list of collections which she considers as *catalinae* from as far north as Oregon, and on the mainland from Berkeley, Monterey, etc. She also cites sheet *80321* in the herbarium of the University of California as the type. The type is without a doubt in the Gray Herbarium, at Cambridge, Massachusetts.

In the herbarium at Kew there is a specimen of Mr. Brandegee's collection of May 13, 1890, from Santa Catalina island, and attached to it a letter to Professor Oliver by Dr. Sereno Watson, written June 24, 1890. That part of the letter referring to this Trifolium is as follows: "There comes now a Trifolium from the Santa Catalina Islands, California, singularly unlike all known native species and strongly resembling T. saxatile of the European Alps. It may be, if not that, (and it differs in some respects—more coriaceous calyx with stiffer erect teeth, and more naked stems), some allied species that is not represented in our herbarium. Will you kindly refer it to Mr. Baker or some one of his assistants, for comparison?"

TRIFOLIUM PETROPHILUM Heller

T. dichotomum forma *petrophilum* McDermott

A small annual 4 to 8 inches high, with a characteristic silver-white hairiness and conspicuous dark purple and white flowers. It is found on several of the higher peaks in Napa and Santa Clara counties, California.

Annual, 1 to 2 dm. high, simple or branched, erect, silvery white rather long pubescent throughout: leaflets mostly similar throughout (in type smaller than usual); lowest leaflets obovate to oblanceolate, obtuse, 6 mm. long; upper leaflets lanceolate, acute, 10 mm. long, all prominently dentate; stipules large for the size of the plant, ovate, 6 mm. long with an acuminate tip 5 mm. long; lower stipules lanceolate and crowded together at the base, membranaceous and pubescent, especially on the margins: peduncles about 3 cm. long, elongating with age: heads terminal or subterminal, at first turbinate, later ovate-conical, 17 mm. long, 13 mm, wide; flowers prominent, corolla extending beyond the calyx teeth about 2mm., dark with white tips: calyx tube 1.5 mm. long, teeth 6 mm. long, plumose hairy: vexillum 9 mm. long, 4 mm. wide, broadly elliptical, obtuse: ovary glabrous, 2-ovuled: style 5 mm. long: legume 3.5 mm. long, barely 2 mm. wide, 1-seeded, somewhat striate, glabrous: seeds oblong, 2.7 mm. long, 1.2 mm. wide, light brown with faint markings.

Napa county: Mt. St. Helena, *Baker 2625* (type).

Santa Clara county: Mt. Hamilton, *Heller 8627*, *C. P. Smith 1468*, *Elmer 2203*, *Gorman*, May 31, 1890; Black mountain, *R. J. Smith*, May 22, 1909.

Trifolium Traskae sp. nov.

An erect villous annual 6 to 8 inches high, branched from the base, with few leaves, long internodes, pedunculate heads of dark purple flowers, and narrow dentate leaflets attenuate at both ends.

This species was collected by myself on Santa Catalina island, California, April 21, 1907, and does not seem to be in the other herbaria that I have examined. On taking the marine gardens launch to Moonestone bay, it was gathered in rather dry situations about 100 feet from the shore. More time for investigating the region might have proven that it was more or less common on that and other portions of the island.

Annual with erect branches from the base, about 2dm. high, villous throughout, internodes long, 5 to 10 cm.: lower leaflets 1 cm. long, 3 mm. wide, elliptical, acute at both ends, margins

coarsely dentate; upper leaflets longer and narrower, attenuate at both ends, not variable like those of *catalinae;* lower petioles 2 to 3 cm. long, upper much shorter, about 5 mm. long; stipules lanceolate below to broadly ovate above, lobes more or less notched and terminated by a long acumination: heads globose to ovate, pedunculate, terminal or subterminal: peduncles 3mm. to 5 cm. long: flowers deep purple: calyx tube 1.5 mm. long, teeth 4.5 mm. long: corolla extending beyond the teeth 2mm. vexillum elliptical, obtuse, 9.5 mm. long, 2.5 mm. wide, very finely erose dentate at the apex: ovary 2-ovuled, ciliate with long hairs: style 5 mm. long: mature legume and seed not seen.

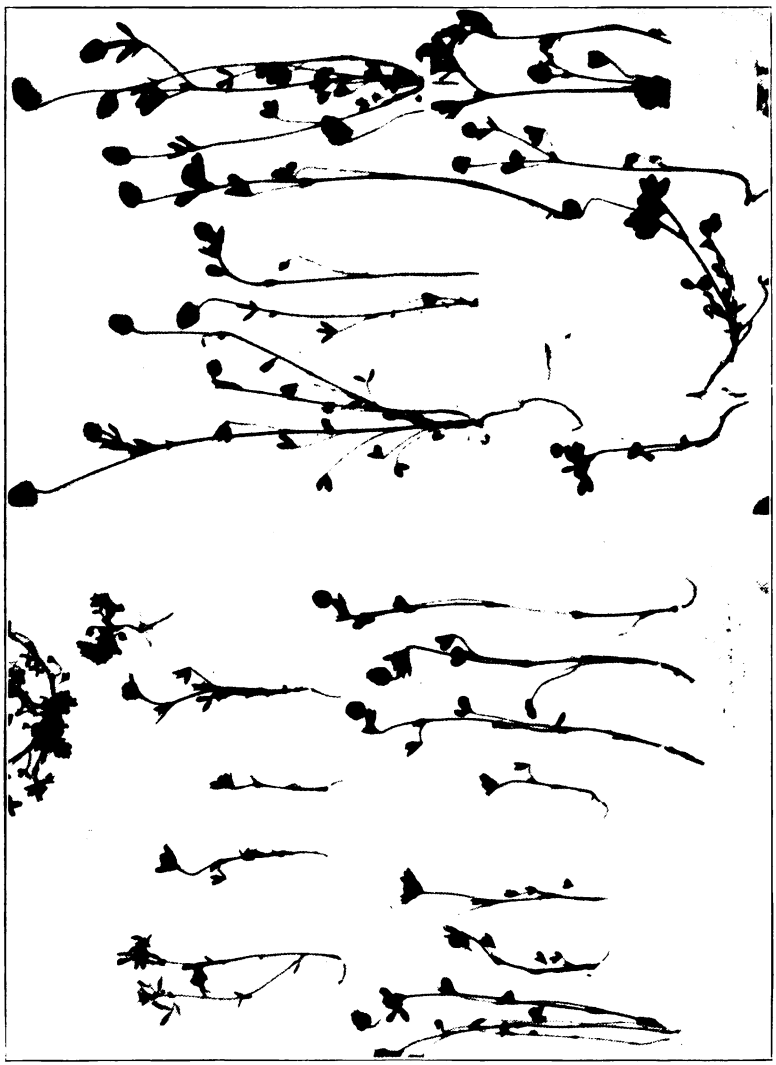
The type is in the herbarium of P. B. Kennedy, and a cotype in the U. S. National Herbarium. In some of its characters this species resembles *dichotomum*, *Macraei* and *catalinae.*

Trifolium pseudo-albopurpureum sp. nov.

A somewhat pubescent annual about a foot high, branching directly or dichotomously from the base, with obovate or oblanceolate leaflets and small, ovate or ovate-conical pedunculate heads. It resembles *Macraei* in the character of the florets, and *albopurpureum* in having long peduncles. The species was collected by myself along the railroad track near Surf, and at Santa Rosa ranch near Lompoc, Santa Barbara county, California. It in no way resembles *neolagopus*, although that is abundant in Southern California. The calyx tube and teeth are of equal length.

Annual, with a close appressed pubescence throughout not readily apparent except under a lens: stems branching from the base upwards, 2 dm. high: basal leaves few and small, soon drying up, obovate-cuneate; upper leaflets oblanceolate, margins entire below and erose dentate emarginate toward the apex, 20 mm. long, 7 mm. wide; petioles of some of the central leaves 4 to 6 cm. long, others much shorter; stipules membranaceous, prominently veined, lanceolate below to broadly obovate above, lobes with sharp acumination, ciliate on the margins, mostly entire or undulate: internodes of main branches about 6 cm. long, of lateral branches much shorter; flowers not showy, pur-

PLATE 5



Type sheet of T. Macraei H. & A.

T. albopurpureum T. & G.

ple tipped with white; heads ovate-conical in fruit, terminal or subterminal, main stem terminating in a peduncle 4 to 6 cm. long, those of the branches much shorter: calyx tube 2 mm. long, teeth 2 mm. long, densely silvery pubescent: corolla extending beyond the teeth about 2 mm.; vexillum 6 mm. long, 2 mm. wide, narrowly elliptical, obtuse, very finely erose dentate at apex: ovary 2-ovuled, hairy: style about 3 mm. long: legume membranaceous, striate, hairy towards the apex, 1-seeded: seeds light brown, not mottled, 2 mm. long, less than 1 mm. wide.

The type is a specimen from Surf, in the herbarium of P. B. Kennedy. A co-type is deposited in the U. S. National Herbarium.

TRIFOLIUM ALBOPURPUREUM T. & G. (Plate 4.)

An ascending or slightly decumbent simple or branched annnal about a foot high, pubescent throughout, but not as densely so as most of the species of the group. The heads are very short peduncled when young, but the peduncles elongate considerably with age. The lower leaflets are smaller and broader than the upper, and inclined to be obovate-cuneate, emarginate, varying as they ascend to broadly, and finally narrowly elliptical leaflets. The corolla in very young flowers is considerably shorter than the calyx. This varies with the age of the flower, and it may slightly exceed the calyx. The vexillum, wings and keel are tipped with white. Both the calyx tube and the teeth are covered with dense white straight hairs. The teeth may be twice or more the length of the tube, according to the stage of growth. This species has been found in California only, and it is very probable that Douglas collected the type in the vicinity of Pacific Grove or Monterey. Taking my plants from Pacific Grove, collected in May, 1907, as being nearest to the type and the drawings on the type sheet, as well as closely answering the original description, the following is drawn from them:

Annual, 2 to 3 dm. high, ascending, simple or branched, pubescent throughout: stems sparingly appressed pubescent for the group: upper internodes 10 cm. long: lower leaves on peti-

oles 4 to 6 cm. long; lower leaflets small, cuneate to obovate, emarginate, about 10 mm. long, 6 mm. wide; upper leaves on short petioles; upper leaflets 18 to 20 mm. long, obovate-lanceolate to elliptical, obtuse, margins remotely dentate; stipules ovate-lanceolate, sparingly hirsute, lower with long acuminate lobes, margins entire: peduncles of young flowers very short, but elongating to 5 cm. or more with age, slender, densely pubescent towards the heads: heads semiglobose when young and ovate-conical with age: calyx tube 2 mm. long, teeth dark colored but pubescent with straight, white hairs, three of the teeth 4.5 mm. long, two 4mm. long: corolla not quite as long as the teeth, purple and white. vexillum 6 mm. long, 2.3 mm. wide, erose dentate at apex: ovary 2-ovuled: style 3 mm. long: legume 2.5mm. long, with a few hairs at the apex, 1-seeded: seeds elliptical, 2 mm. long, 1.1 mm. wide, very light brown, sometimes faintly mottled.

Other collections which must be included for the present under this species, though not typical, are:

West Berkeley. *Herbert M. Evans*, May 14, 1901, has a longer calyx tube and shorter teeth, and a larger and more prominent corolla (mature plant).

West Berkeley. *Kennedy*, May, 1907; probably the same as above, but very young plants.

Charter Hill, Berkeley. *Kennedy*, May, 1907; floral structure more like *Macraei*, but plant not like that species.

Back of San Mateo on Half Moon bay road. *Heller 8554;* resembles *olivaceum* in general appearance, but it can not be that species. I take it to be a luxuriant form of *albopurpureum.*

Berkeley Hills. *Miss K. Jones*, April 21, 1901; a robust form with very large leaves and vexillum.

Near Mill Valley, Marin county. *Tidestrom*, May 11, 1895. Woodside, San Mateo county, *Abrams 2420.* Forms with short tube and teeth, and few leaves.

San Luis Obispo county. *Mrs. Summers;* nearly typical, except that mature flowers extend beyond the calyx teeth.

TRIFOLIUM NEOLAGOPUS Loja.

T. albouprpureum var. *neolagopus* McDermott

Annual, villous throughout, with ovate-conical heads and inconspicuous flowers equaling or extending very slightly beyond the calyx teeth. It is fouud only in the southern counties of California.

Annual, villous or somewhat glabrate in age, erect or spreading, much branched: stems hollow when young: internodes long: lower leaves few, obovate-cuneate; cauline long petioled, oblong, uppermost sessile, acute, serrulate: stipules membraneous, nerved, ovate, linear subulate, setaceous: peduncles nodding and short before anthesis, afterwards prolonged and erect: flowers numerous in the head: heads large, globose-hemispherical in flower and ovate conical in fruit, densely cinereous villous: calyx subcoriaceous, tube very short, about 1 mm. long with 10 prominent dark nerves, villous; teeth 5 mm. long, triangular at base, becoming linear, setaceous, densely covered with long silvery hairs (brown in old specimens): corolla in flower equaling or slightly exceeding the calyx teeth, in fruit dried up, twisted and shrunken; vexillum elliptical, obtuse, 6 mm. long, 2.5 mm. wide, apex irregularly and finely dentate, obtuse, amethyst blue below, shading to light blue (in dried specimens or old flowers appearing brownish white at apex); wings acuminate, dark purple, slightly shorter than the vexillum: ovary with a few long hairs at the apex: style long, stigma capitate: legume 1-seeded, membranaceous, striate: seeds oval, shiny, olive green to yellow, irregularly mottled with dark purple, 2.1 mm. long, 1.2 mm. wide.

This species does not vary to the extent of *columbinum*, and is confined to the southern counties of California. The type was collected by Mrs. Elwood Cooper in the Santa Ynez mountains, Santa Barbara county, in 1876. The following collections will indicate its distribution:

Kern county: Near Caliente- *Heller 7626;* San Emigdio canyon, *Davy 1983;* Keene Station, *Heller 7800;* Tehachapi, *Heller 7835;* Fort Tejon, *Davy 2360.*

Fresno county: Near Pollasky, *Heller 8152.*

San Bernardino county: Fredalba, *Heller 8948;* San Bernardino, *Parish* (many collections); Redlands, *Parish.*

Los Angeles county: Saugus, *Grant 1320d;* Los Angeles, *Grant 1311;* Pasadena, *Grant 1312;* Santa Monica, *Hasse;* no locality, *Fritchy;* no locality, *McPherson;* Altadena, *Grant 6180h.*

San Diego county: Bernardo, *Abrams 3369;* Vallecito, *Orcutt*, May 22, 1886; Valley del Mar, Angier, Ramona, *Brandegee*, May 25, 1903.

Riverside county: Riverside, *Hall 3817;* Colton road, *Reed 1308.*

These may be found in herbaria under the following names: *T. Macraei albopurpureum*, *T. Macraei*, *T. dichotomum*, *T. columbinum*, *T. albopurpureum*, *T. ciliatum*, *T. Macraei* var. *dichotomum*, *T. neolagopus*, *T. albopurpureum* var. *neolagopus.*

The character of the calyx having two of the teeth joined higher up on the tube than the others is frequent in *neolagopus*, but it may also occur in *columbinum.*

The figure of the vexillum of *T. neolagopus* on page 210 of North American Trifoliums, by McDermott, does not resemble the species. It is broad and inflated at the base and not emarginate at the apex. An examination of *Heller 7835*, from which the drawing was made, will show no such vexillum. In the lower figure one recognizes at once the vexillum of *columbinum.* Also in that work the northern localities mentioned under "specimens examined" of *albopurpureum* var. *neolagopus* forma *argillorum* should be placed with *columbinum*, while the southern ones are good *neolagopus*

We have grown the plant without difficulty in the grounds here, both outside and in the greenhouse. Althongh it is 2-ovuled, we have never found more than one seed developing in the pod. McDermott no doubt takes for granted that both ovules produce a seed. The species is abundant in southern California, both in the coast and interior counties, preferring rich dry soil, and has little to recommend it for introduction as a forage plant.

Trifolium Helleri sp. nov.

A slender stemmed simple or branched annual, pubescent throughout with rather long white hairs. The leaves are extremely variable in the different collections of Dr. Heller. No. *7416* from Los Gatos shows a marked deviation from the type. My specimens, collected at Los Gatos, Santa Clara county, California, May, 1907, represent the average, hence I have chosen them for the description. In very young plants the flowers show quite prominently, but as they mature the calyces lengthen and conceal the flowers after the manner of *T. columbinum*.

The mature plants have very long slender peduncles. The specimens vary from 6 inches when young to 1½ feet when mature. The cotyledons are 6mm. long and 2.5 mm. wide. The first leaf is simple and almost glabrous on both surfaces, only three hairs being detected on the living plant. The blade is 3 mm. long, 4 mm. wide, broadly truncate at the apex. The petiole is sparsely hairy for the group.

The species seems to be somewhat local in its distribution, having been collected only in Santa Clara county, California, but in a number of different places by several collectors. It will be found in herbaria under the names *albopurpureum* or *columbinum*.

Annual, about 3 dm. high, erect or ascending, pubescent throughout with rather long hairs: internodes 5 to 10 cm. long: leaflets narrowly elliptical, acute at both ends, 2 cm. long, 4mm. wide, remotely dentate serrate (in some specimens broader with almost spinulose margins); petioles of lower leaves 4 cm. long, upper very short; stipules ovate-lanceolate with a long acumination, mostly entire: flowers inconspicuous: peduncles elongating with age, 6 cm. or more, slender: heads terminal or subterminal, semi-globose when young, ovate-conical in fruit, bluish gray: calyx tube 1.2 mm. long, teeth villous, 5 mm. long: vexillum ovate, obtuse, slightly inflated at base, 5.5 mm. long, 2.5 mm. wide; corolla equaling or shorter than the teeth, according to the stage of growth, deep blue shading to light blue at the apex: ovary 2-ovuled: style 3mm. long: legume broadly oblong, hairy, thin membranaceous, 3mm. long, 2.5mm. wide, 1-seeded:

seeds light brown mottled with dark brown, elliptical, 2 mm. long, 1 mm. wide.

The following collections have been placed under this species: Los Gatos, May, 1907, *Kennedy* (type) in herbarium of P. B. Kennedy, *Heller 7330, 7416;* between Mission San Jose and Livermore, *Heller 7313;* Stanford University, *Abrams*, April, 1898, *Baker 862;* Gilroy, *Elmer 4623.*

T. Helleri resembles *T. albopurpureum* in general appearance, but has different leaves, calyx teeth and vexillum.

TRIFOLIUM COLUMBINUM Greene

T. olivaceum forma *columbinum* McDermott

An erect annual about a foot high, simple or branching, with silvery white appressed hairs throughout, and rather long peduncled heads, at first orbicular-ovate, but decidedly conical with age. The corollas are entirely concealed by the dense silky plumose silvery hairs on the calyx, giving the head a soft rather than harsh appearance. In herbarium specimens the heads turn brown with age.

Annual, with or without ascending branches, appressed pubescent throughout: internodes 6 to 8 cm. long: lower leaflets few and small, less than 1 cm. long, oblanceolate-cuneate, dentate, soon drying up; upper large, variable, 2 cm. or less long, 1 cm or less wide, oval to oblanceolate, mostly obtuse, margins dentate to crenate; petioles about 4 cm. long, uppermost very short; stipules prominently veined, lobes ovate-lanceolate to ovate, terminated by a short acumination, entire or sparingly notched: peduncles 2 to 6 cm. long: heads terminal or subterminal, one or two terminating the branches, globose when young, conical with age, 2.5 cm. long, 2 cm. wide, densely silky villous: calyx tube very short, 1 mm. long, teeth 7 mm. long, densely villous to the apex: corolla inconspicuous, extending only about half the length of the calyx teeth, white and purple; vexillum ovate-lanceolate, obtuse, 6 mm. long, 2.8 mm. wide (slightly inflated in fruit), obtuse: ovary densely villous, 1-ovuled: style 1.5 mm. long: legume thin, membranous, striate, villous, 5 mm. long, 2.1 mm. wide, 1-seeded: seeds broadly ovoid, brown, 3mm. long, 1.6 mm. wide, devoid of markings.

T. columbinum has a much wider distribution than is generally supposed. McDermott states that it "is rare, not found some seasons," and collected only in middle western California. Our investigations show that it occurs all the way across the state from Sonoma to Amador counties. It can not in any sense be considered a form of *olivaceum*, as it has a different floral structure. The drawing of the vexillum of *T. olivaceum* on page 212 of North American Trifoliums is inaccurate. The apex is very broad, not pointed, as in the figure. Indeed, it is of almost equal width throughout (compare figures 4 and 5, plate 1). It is also only slightly inflated at the base. *T. columbinum* is broad at the base and gradually tapers toward the apex, where it is decidedly acute. It is the only species of the group in which this character is very pronounced. It is also very much inflated at the base, particularly in mature specimens. On page 214 of North American Trifoliums, the plate of *T. olivaceum* represents a portion of a plant, one of the heads supposed to be *olivaceum* and the other *columbinum*. We are led to believe that both species occur on the sume plant.

The species varies considerably from the type collected at Vacaville, Solano county, to depauperate specimens like those from Ione, Amador county, *Hansen 1583*. The above represent the extremes and differ somewhat in general appearance, but they both have the characteristic vexillum. Between these are a number of collections which show the gradual variation from the type. This is no doubt due to environmental conditions, probably aridity, poorer soil, and higher elevation. The following sheets are mentioned as showing the gradual variation of the species and its distribution:

Near Vacaville, Solano county, *Heller and Brown 5391* (typical); Agua Caliente, Sonoma county, April 22, 1902, *Heller;* Clear Creek, Butte county, *Brown 157;* Marysville Buttes, Sutter county, *Heller 7578;* Chico, Butte county, *Copeland 3025;* Ione, Amador county, *Hansen 1583*.

TRIFOLIUM OLIVACEUM Greene

A striking annual, appearing glabrous, but strongly appressed pubescent throughout under a lens. The strongly nerved calyx tube and rigid teeth tinged with purple give it a harsh appearance, unlike any other species of the group. The flowers are at first deep purple, never conspicuous, and always much shorter than the calyx teeth. The heads are olive green, not silver gray as in *columbinum*. It was apparently first collected by Kellogg and Harford, no. *140*, in 1868 or 1869, the exact locality in California not given. This specimen is in the herbarium of the Missouri Botanical Garden, determined as *T. plumosum*, and later as *T. Macraei*.

Annual, erect, with ascending branches, silky appressed pubescent throughout, sparsely so on the stems: internodes 4 to 8 cm. long: lower leaflets obovate-cuneate, emarginate dentate, 1 cm. long, soon drying up; upper ones longer and narrower, variable, obovate-cuneate to oblong and oblanceolate, mostly obtuse, dentate, about 2cm. long; petioles 3 to 5cm. long, upper ones much shorter: stipules membranaceous, lobes lanceolate to ovate with a long acumination, more or less notched: peduncles 7 cm. long: flowers inconspicuous: heads terminal or subterminal, one or two on each branch, globose, inclined to ovate conical in fruit, 1 cm long and as wide, villous: calyx tube short, 2 mm. long, teeth setaceous, 9 or 10 mm. long, villous below, becoming almost naked toward the apex, rigid and usually purple tinged: corolla deep violet purple, inconspicuous, reaching to about half the length of the calyx teeth; vexillum oblong, narrow, 8 mm. long, 2.5 mm. wide, obtuse, apex irregularly dentate: ovary pilose, 2-ovuled: style 4.5 mm. long: legume membranaceous, glabrous except for a few hairs on the dorsal suture near the apex, light colored, striate, 3.5 mm. long, 2 mm. wide, 1-seeded: seeds oval, 2 mm. long, 1 mm. wide, light yellowish brown, with a few dark markings at one end.

Solano county: Near Vacaville, *Heller and Brown 5394;* Vanden, *Kennedy*, May, 1907.

Napa county: Near Napa, *Heller and Brown 5359.*

Contra Costa county: Antioch, *Mrs. Brandegee*, May, 1907.

California, *Kellogg and Harford 140*, 1868-69.

In the original description the word "glabrous" as applied to the stem and leaves is misleading. The upper surface of the leaves appeaasr as if glabrous, but is distinctly pubescent under a lens. Also the expression "naked peduncles" should be appressed pubescent under a lens.

Trifolium insularum sp. nov.

An erect annual somewhat resembling *olivaceum*, with inconspicuous purple flowers and long rigid teeth. It seems to have been collected only on Catalina island, California, which is far removed from any known station for *olivaceum*, its nearest relative. It has been called *catalinae*, but differs very materially from the type of that species in having heads with long peduncles, long calyx teeth and inconspicuous flowers.

The type, in the herbarium of the Missouri Botanical Garden, was collected by Mrs. Trask in May, 1897, with the statement that it occurs in three localities, two in canyons and one by the edge of the sea.

Annual, erect, about a foot high, branched from the base, pubescent throughout: lowest leaflets cuneate to obovate, on petioles 3 cm. long; upper leaves elliptical, margins coarsely dentate; stipules ovate-lanceolate with a long apiculation, membranaceous, glabrous below but somewhat hairy above: internodes 5 to 8 cm. long: peduncles 3 to 10cm. long: flowers inconspicuous. purple: calyx tube 2mm., teeth 6mm., hirsute rather than plumose and somewhat rigid: corolla extending ¾ the length of the teeth; vexillum 7.5 mm. long, 1.7mm. wide, elliptical: ovary 2-ovuled: style 3 mm. long, narrow: legume 3 mm. long, 1.3 mm. wide, membranaceous, glabrous, 1-seeded: seeds dark brown, not mottled, narrowly oblong, 2 mm. long.

[The whole of this number, pages 1 to 29, was issued March 7th, not February 28th, as is indicated on some pages.]

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A. A. Heller,

539 West 5th street, Reno, Nevada

Volume 9 Number 3

MUHLENBERGIA

MARCH, 1913

Editors: A. A. HELLER and P. BEVERIDGE KENNEDY

Quercs lobata

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Volume 9 April 30, 1913

MUHLENBERGIA

ADDITIONS TO THE FLORA OF THE BLACK HILLS OF SOUTH DAKOTA—III

By Stephen Sargent Visher

Additions I. (1) and II. (2) dealt with the Hills proper. This list treats of the southern foothills and the Cheyenne valley just south of the Hills. The area embraced is Fall River county, the most southwesterly county of South Dakota. About one-third of this county is included within the Black Hills as that term is narrowly applied, while all of it is included by a looser definition. The collection upon which these notes are based was made for the South Dakota State Survey, July 24th to August 6, 1911. The determinations are by Dr. Aven Nelson, of the Rocky Mountain Herbarium, at Laramie, Wyoming.

By comparison with "The Flora of South Dakota," (3) it was found that about 31 species are here first reported from the state. These uames of these are in italic. Some 12 additional are new to the Black Hills region, but have hitherto been found in portions of eastern South Dakota. The former South Dakota "range" is given in parentheses. Four more species hitherto only known from a single South Dakota locality are mentioned. Nine other species recorded by Rydberg from the Black Hills(4) but omitted by Saunders are mentioned.

(1) Torreya **9**: 186-188. 1909. (16 Black Hills records; 8 state records.

(2) Muhlenbergia **8**: 135-137. 1913. (21 Black Hills records; 19 state records.)

(3) Bulletin 64, South Dakota Experiment Station, Brookings, 1899.

(4) Cont. U. S. Nat. Herb. **3**: 463-536. 1896.

The references to Washington, Bennett and Washabaugh counties are based on a collection made in 1911, determined by Dr. P. A. Rydberg, of the New York Botanical Garden. For a full list see Bulletin 5, South Dakota Geological Survey, November, 1912. The Harding county collections were determined by Aven Nelson. For a complete list see Bulletin 7 of the South Dakota Geological Survey, 1913.

EQUISETUM FLUVIATILE L.? Horsetail.

Tolerably common along streams; (Minnesota valley).

AGROPYRON OCCIDENTALE Scribn. Wheat grass.

Common along streams. Reported in 1894 as *A. repens glaucum* by Rydberg, but given only from eastern South Dakota by Saunders.

AGROSTIS ALBA L.

Plentiful on stream margins throughout the foothills. Though Rydberg recorded it from the Hills, Saunder's Catalog mentions it only from an extreme eastern locality.

AGROSTIS ASPERIFOLIA Trin.

Common along streams. Reported under *A. exarata* by Rydberg as rare near Hot Springs.

Bromus Richardsonii Link. "Wild oats"

Rare along some of the valleys of the foothills. Not believed by Rydberg to be distinct from *B. ciliatus*.

CALAMAGROSTIS MONTANENSIS Scribn.

Locally abundant along streams; (James and Sioux valleys).

Muhlenbergia comata (Thurb.) Benth. Dropseed.

Abundant on foothills.

Puccinellia airoides (Nutt.) Wats. & Coult.

Plentiful in valleys.

Sitanion Hystrix (Nutt.) J. G. Smith.

Rare on the foothills near Edgemont.

Sporobolus brevifolius (Nutt.) Scribn.

Abundant along all streams. Also collected in Washington county.

SPOROBOLUS CRYPTANDRUS (Torr.) Gray

Rare along Hat creek; also in Washington county. Mentioned by Saunders only from east of the Missouri, though Rydberg collected it in the Hills.

CYPERUS SCHWEINITZII Torr.

Locally common on Softwater creek, also in Harding and Washabaugh counties; (eastern South Dakota).

Scirpus campestris Britton

Abundant along alkali streams.

Scirpus microcarpus Presl

Everywhere along streams.

CAREX AUREA Nutt.

Rare along streams. Also in Harding county; (near Lead).

CAREX NEBRASCENSIS Dewey

Very plentiful along streams; (near Lead).

JUNCUS LONGISTYLIS Torr.

Plentiful along permanent streams; also in Bennett county; (near Lead).

POPULUS OCCIDENTALIS (Rydb.) Britton. Western cottonwood.

Dominant on the larger streams. This was formerly included in *P. deltoides.* Rydberg states that the name *occidentalis* is preoccupied by fossil forms, and hence this species should be called *P. Sargentii.*

Salix amygdaloides Anders.? Peach leaved willow.

Abundant in valleys.

SALIX EXIGUA Nutt.

Forming thickets on flood plains of all running streams; (also in Bennett county). Included by Rydberg in 1894 in *S. fluviatilis.*

POLYGONUM HARTWRIGHTII Gray? Smartweed.

Common along streams; (Sioux valley).

Polygonum incarnatum Ell.

Frequent along streams.

ACMISPON IN CALIFORNIA

By A. A. Heller

While this group of plants is nearly related to the genus *Anisolotus* of Bentham, recently revived, in habit and in several pronounced characters, it seems to be distinct. Rafinesque founded *Acmispon* upon *Lotus sericeus* Pursh, an untenable name, the equivalent of which is *Trigonella americana* Nutt. Dr. Rydberg has recently revived *Acmispon* as a genus, and transferred to it the names of two species found in the Rocky mountain region.

For some years I have been interested in the medly of plants called "*Lotus americanus*," chiefly through field observations in California. Press of other duties and doubt as to the identity of the several Nuttallian species described under *Hosackia* has delayed publication.

Probably all of Nuttall's species are valid. Rydberg has recognized *elata*, and Piper, Cont. U. S. Nat. Herb. **11**: 366, considers *pilosa* sufficiently distinct to be called a variety.

The species of *Acmispon* fall into two groups, one with peduncles longer than the leaves, the other with peduncles shorter than the leaves. The short peduncled group is divided, at least in California, into species with large flowers and species with small flowers.

It is greatly to be regretted that Rr. Rydberg, who probably has access to typical material of all of Nuttall's species, has not given us good descriptions, or at least a key to them, instead of merely publishing new combinations. Nuttall's descriptions, like many others, are so general that identification from them alone is almost impossible.

While *Anisolotus parviflorus* and its several near relatives bear a general resemblance to *Acmispon*, a little scrutiny soon shows that they can not be included.

Acmispon Raf. New Flora **1**: 53. 1836.

Annuals, either diffusely branched from the base and decumbent, or erect or ascending, sometimes with but few branches, generally decidedly pubescent, but occasionally glabrate. Leaves

pinnately 3-foliolate, or 1-foliolate toward the ends of the branches, subsessile or very shortly petioled, the terminal leaflet petioled. Peduncles shorter or longer than the subtending leaf, 1-flowered, bearing a foliaceous bract at the summit. Flowers on pedicels 1 to 1.5mm. long, drooping at night. Calyx half to three-fourths the length of the corolla, adhering to the pod, its tube campanulate, about one-third the length of the lobes. Corolla white, pinkish or salmon color, the vexillum usually longer than the other petals, well curved away from them at the apex. Pods linear, usually rounded when mature, brown, somewhat attenuate at the unguiculate apex. Seeds oblong, rounded, smooth and shining.

KEY TO THE CALIFORNIAN SPECIES

Peduncles longer than the leaves	
Plants erect, few flowered	
Glabrous or nearly so	A. gracilis
Pubescent with spreading hairs	A. mollis
Peduncles shorter than the leaves	
Flowers large, 7 mm. or more long	
Plant erect, few flowered	A. sparsiflorus
Plant decumbent, many flowered	A. aestivalis
Flowers small, less than 7 mm. long	
Plant decumbent, villous	A. pilosus
Plant decumbent, glabrate	A. glabratus

Aemispon gracilis sp. nov.

Annual, erect, 3 to 4 dm. high: stems slender, glabrous below, sparingly pubescent above, branched from below the middle, the branches ascending: internodes long: leaves few, petioles 1 mm. long: leaflets elliptical oblong, acute, yellow-green above, paler beneath, the lateral ones subsessile, 13 mm. long, 3 mm. wide, terminal one 17 mm. long, 4 mm. wide, the petiolule 4 mm. long: flowers mostly terminal, few: pedicels longer than the subtending leaves, 16 mm. long: bracts narrowly elliptical, 5 or 6 mm. long, 1.5 mm. wide: calyx pubescent with slightly spreading hairs, tube 2mm. long, lobes subulate, ciliate, 3 mm. long, less than 1 mm. wide at base: corollas pinkish or salmon, apparently not veined, 9 mm. long, 5 mm. deep; banner ovate orbicular when spread out, 9 mm. long, 7 mm. wide, its

ONOSMODIUM OCCIDENTALE Mackenzie

Plentiful on dry rocky soil; also in Washabaugh county. Included in 1894 in *O. molle* by Rydberg.

MONARDA MENTHAEFOLIA Graham. Horsemint.

Common along flood plains; also in Washabaugh and Harding counties. "The same as *M. fistulosa mollis* of western reports."—Rydberg.

SCROPHULARIA OCCIDENTALIS (Rydb.) Bicknell

Tolerably frequent along creeks. *S. nodosa occidentalis* was described by Rydberg in his Black Hills report. It was not mentioned by Saunders, however.

ECHINOCYSTIS LOBATA (Michx.) T. & G.

Common along Horsehead creek; also in Harding county; (eastern South Dakota).

Artemisia tridentata. Sagebrush.

Dominant on the higher terraces; also in Harding and Washington counties.

Erigeron caespitosus Nutt.

Common in the woods of the foothills.

Grindelia perennis A. Nelson? Gum plant.

Very numerous on uplands throughout, less common along valleys; also in Harding county.

Helianthus Nuttallii T. & G. Sunflower.

Abundant on floodable portions of valleys, in willow groves, etc.

Helianthus subrhomboideus Rydb.

Rare along Indian creek. Rydberg believes the western sunflower previously included in and reported as *H. scaberrimus* is distinct.

Solidago elongata Nutt. Golden rod.

Rare on the prairies near Ardmore.

Solidago nana Nutt.

Plentiful on the plains.

TRAGOPOGON PRATENSIS L. Salsify, Oyster plant.

Common in fields and in moist areas elsewhere; also in Washington county; (Minnesota and Sioux valleys).

XANTHIUM ECHINATUM Murr. Cocklebur.

A pest in flooded areas of flood plains; (eastern South Dakota.

State University, Vermillion, South Dakota.

THE OAKS OF THE PACIFIC SLOPE—I

BY A. A. HELLER

While a number of the oaks of the west side of the continent become very large, none of them can be classed as lumber trees on account of their habit. They develop short thick trunks which soon give place to massive, spreading branches, and are usually suitable for such lumber only as can be manufactured into articles requiring short lengths. Their chief use is for fuel, for which purpose they are extensively used, the wood bringing a good price.

Much of the beauty of California valleys and park-like slopes is due to the several oaks, both deciduous and evergreen, which inhabit them. Many fine examples may be found in the Santa Clara valley south of San Francisco, in Sonoma and Napa counties, and in the Sacramento valley. Nearly all of the early explorers mention the beautiful oak groves through which they passed.

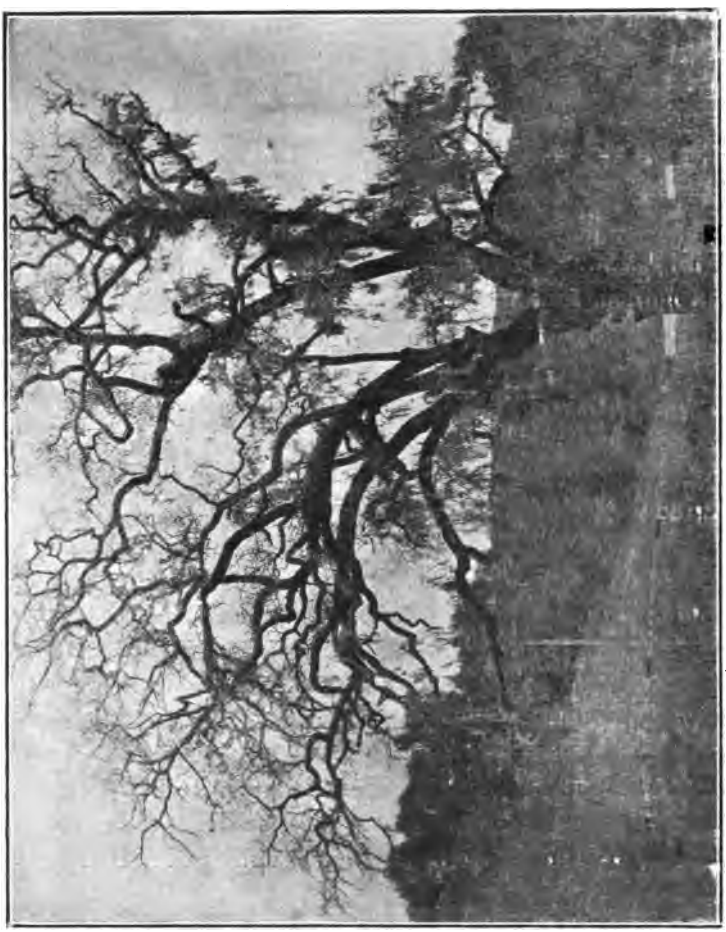
It is my intention in this series of papers to illustrate and describe the most important of the oaks found on the Pacific slope, taking first those belonging to the white oak series.

QUERCUS LOBATA. Valley oak.

QUERCUS LOBATA Nee, Anal. Cienc. Nat. **3**: 278. 1801.

The common form of this tree when mature is the one shown in plate 6. The average height is about 50 feet, the spreading and drooping branches usually extending for a greater distance than the height of the tree. The trunk is 2 to 5 or

Plate 6



Quercus lobata. Los Gatos canyon near Lexington, Santa Clara county, California

Plate 7

Quercus lobata. Mayfield, Santa Clara county, California

Plate 8

Quercus lobata

more feet in diameter, soon dividing into several heavy branches. The gray bark of old trees is often 4 inches thick, broken into small plates an inch or two across with deep fissures between. The leaves are 3 or 4 inches long, 2 or 3 inches wide, green above, pale beneath with a close, short pubescence, deeply lobed, the lobes broad and rounded. The cup of the acorn is a half to nearly an inch deep, gray-brown, the scales very prominent, the acorn 1½ ro 2½ inches long, ½ to ¾ inch in diameter, brown when mature.

This oak is found in California only, and as indicated by the common name, is especially a tree of the valleys, although it may occur at considerable elevations, being found as high as 4500 feet in the southern part of its range. Its northern limit is in the neighborhood of Redding, at the head of the Sacramento valley, and in the Coast Range valleys west of that point. Southward its interior limit is Fort Tejon, at the head of the San Joaquin valley, and in the coast region it is found as far south as Saugus, between Santa Barbara and Los Angeles.

It favors valleys protected from the cold ocean winds, and in these, in rich soil, reaches its best development. Some very fine examples may be seen in the Santa Clara valley between San Mateo and San Jose, as well as farther south in the vicinity of Gilroy. These localities are all within the fog belt.

Fine trees are also found in the Sacramento valley, and in fact everywhere within its range many magnificent examples occur. Young trees which are growing vigorously are usually of more erect habit, the branches ascending, the drooping tendency but little developed, while trees which have reached maturity are characterized by spreading and drooping branches. They reach maturity in from 125 to 300 years.

An abundance of fruit is produced, but little of it germinates as a rule, owing to the fact that the trees are usually found in pastures or cultivated fields, where conditions are not favorable for growth. The acorns are sweet and palatables and were an important article of food for the Indians, who ground them and made a sort of bread from the flour. Squirrels and other rodents consume large quantities of them.

Compared with the eastern white oak, *Quercus alba*, the wood of this species is very inferior being brittle and weak, often cross-grained and difficult to split or work. Only young and vigorous trees might be utilized for manufacturing purposes, as the wood of such trees is stronger and more serviceable. The chief use to which it is put is for fuel, a large tree yielding many cords of firewood.

Its best development is reached in deep, rich soil, and large trees may always be depended upon as an index to the character of the land. It was first collected near Monterey in 1792 by officers of the Malaspina expedition.

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539 West 5th street, Reno, Nevada

Volume 9 Number 4

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APRIL, 1913

Editors: A. A. HELLER and P. BEVERIDGE KENNEDY

Quercus Douglasii

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ADDITIONS TO THE FLORA OF SOUTH DAKOTA—I

By Stephen Sargent Visher

The following list of ninety odd species is a part of a collection of about 400 species made by me for the South Dakota Geological and Biological Survey in July and August, 1911. The determinations are by Dr. P. A. Rydberg. After comparison with the published reports (**1**) dealing with the flora of South Dakota, it appears that the following are first records for the state. The county names in parentheses are those from which Dr. Rydberg examined specimens. They are located in the southwestern part of the state. The synonyms are my additions. Neither the bad lands nor the sand hills of South Dakota had been botanically explored before, which is an explanation of the large number of species added to the flora.

Equiselum hyemale L. Scouring rush, pipe stem.

Occasional along valleys; (Washabaugh county).

Equisetum robustum A. Br.

Occasional along streams, especially in the sand hills; (Washabaugh county).

Equisetum variegatum Schleich.

Common along stream banks throughout; (Washabaugh county).

(**1**) 1. P. A. Rydberg. Flora of the Black Hills. Cont. U. S. Nat. Herb. **3**: 463-536. 1896.

2. D. A. Saunders. Flora of South Dakota. Bulletin 64, South Dakota Experiment Station, Brookings, 1899.

3. S. S. Visher. Additions to the Flora of the Black Hills. I. Torreya **9**: 186-188. 1909; II. Muhlenbergia **8**: 135-137. 1913; III. Muhlenbergia **9**: 33-39. 1913.

JUNIPERUS SCOPULORUM Sargent. Red cedar or juniper.
Common in the bad lands and brakes on the sides of buttes and occasional in flood plains of valleys; (Washabaugh county).

ALISMA SUBCORDATA Raf. Water plantain.
Rare along almost all the streams; (Washabaugh county).

AGROPYRON ALBICANS S. and W.
Rare in the draws of bad lands; (Washington county).

AGROPYRON SMITHII Rydb. Western wheat grass.
One of the dominant grasses of the region, especially on flood plains; (Washington county).

ARISTIDA LONGISETA Steud. Three awned bunch grass.
Often dominant on hillsides; (Washabaugh county).

BROMUS PURGANS L. Brome grass.
Scattered individuals in tall grass along creeks; (Shannon county).

CENCHRUS CAROLINIANUS Walt. Southern sandbur.
On the sandy areas; (Bennett county).

DISTICHLIS STRICTA (Torr.) Rydb. Spike grass.
Abundant on dry flats, especially about depressions; (Washington county).

HORDEUM PUSILLUM Nutt. Southern squirrel tail.
In dry places in Washabaugh county.

SPOROBOLUS BREVIFOLIUS (Nutt.) Nash. Drop seed. "*Muhlenbergia Richardsoni*" Rydb.
Tolerably frequent in ravines; (Washington county).

SORGHASTRUM NUTANS (L.) Nash
Rare in the sand hills near La Creek; (Shannon county).

CAREX EMORYI Dewey
Locally abundant on Bear creek, Washabaugh county.

CAREX STIPATA Muhl.
Quite general in tall grass of the draws of the plains, and in ravines; (Bennett county).

CYPERUS DIANDRUS Torr.

Rare along streams; (Washabaugh county).

CYPERUS SPECIOSUS Vahl.

Occasionally abundant in ravines of escarpments; (Washabaugh county).

JUNCUS DUDLEYI Wiegand. Upland rush.

General in the tall grass of ravines; (Bennett and Washabaugh counties).

NEMEXIA LASIONEURON (Hook.) Rydb. Carrion flower.

Fairly common in the moister groves along the streams of southeastern Washabaugh county.

SISYRINCHIUM SEPTENTRIONALE Bicknell. Blue-eyed grass.

Common in the valleys of La Creek; (Bennett county).

SALIX CORDATA ANGUSTATA Anders.

Fairly common along brooks; (Washabaugh county). *Salix linearifolia* Rydb.

SALIX LUTEA Nutt.

Fairly common along the brooks; (Washington county).

ATRIPLEX NUTTALLII Wats. Saltbush.

Common on the prairies and abundant in the bad lands; (Washabaugh and Washington counties).

CHENOPODIUM PRATINCOLA Rydb.

Abundant on banks along streams and about ponds; (Washabaugh county).

SALSOLA PESTIFER A. Nelson. Russian thistle.

Abundant.

SARCOBATUS VERMICULATUS (Hook.) Torr. Greasewood.

Common in the bad lands; (Washabaugh county).

AMARANTHUS TORREYI (Gray) Britton

An occasional ruderal; (Bennett county). This establishes a new northern record, as it has not been reported from north of Colorado.

FROELICHIA CAMPESTRIS Small

Frequent in the sand hills near La Creek; (Bennett county).

PARONYCHIA DIFFUSA A. Nelson. Whitlowwort.
Rare in bad lands on barren rocks; (Washington county).

BATRACHIUM DRUETII Wym. Water buttercup.
Rare, emersed in water of Medicine root creek; (Washington county).

ARGEMONE INTERMEDIA Sweet. Prickly poppy.
Common; especially on hillsides; (Washabaugh county).

CRISTATELLA JAMESII T. & G. Yellow flowered bee plant.
Abundant in the sand hills; (Bennett county).

RIBES INEBRIANS Lindl. Currant.
Common on rocky hillsides.

RIBES ODORATUM Wendl.
In shady groves along streams; (Washington county).

DRYMOCALLIS AGRIMONIOIDES (Pursh) Rydb.
Common on plains throughout; (Bennet county).

ROSA ARKANSANA Porter. Prairie rose.
Abundant on plains, especially in sand;(Washington county).

ROSA MAXIMILIANI Nees. Wood rose.
Forming large and high thickets in open woods; (Washabaugh county).

ROSA SUFFULTA Greene
Abundant in the sand hills; (Bennett county).

CRATAEGUS SHERIDANA A. Nelson? Thorn apple.
Forming thickets in coulees on sides of high divides and along the more canyon-like valleys; (Shannon county).

ASTRAGALUS TENELLUS Pursh
Abundant on rocky bunch-grass hillsides; (Washabaugh county).

MEIBOMIA DILLENII (Darl.) Kuntze. Showy legume.
Very abundant along Wounded Knee creek and in the sand hills. Greatly extends the range, from southeastern Nebraska; (Shannon county).

PSORALEA LINEARIFOLIA T. & G.
Rare near Porcupine Peak; (Shannon county).

XANTHOXALIS BUSHII Small. Wood sorrel, Oxalis
Common in moist depressions; (Bennett county).

CATHARTOLINUM COMPACTUM (A. Nelson) Small. Wild flax.
Plentiful on hillsides; (Washington county). *Linum compactum* A. Nelson.

RHUS CISMONTANA Greene. Scarlet sumac.
Common on the hillsides to the eastward of the eastern edge of the Pine Ridge Reservation; (Bennett county).

HYPERICUM MAJUS (Gray) Britton. St. John's wort.
Abundant on La Creek; (Bennett county).

NUTTALLIA STRICTA (Osterhout) Greene
Common on sand hills and hillsides; (Washington county).

ANOGRA LATIFOLIA Rydb.
Common along La Creek; (Bennett county).

OENOTHERA MURICATA L. Yellow evening primrose
Abundant along Wounded Knee creek; (Shannon county).

OENOTHERA RHOMBIPETALA Nutt.
Quite numerous in the sand hills; (Bennett county).

PACHYLOPHUS MACROGLOTTIS Rydb. Gumbo lily.
Abundant in the bad lands on bare clay; (Washington county).

AMMI MAJUS Walt.
Rare on wet soil; (Washington county). *Ptilimnium capillaceum* (Michx.) Hollick.

SUIDA STOLONIFERA RIPARIA Rydb. Dogwood, red osier.
Frequent on banks of streams; (Washabaugh and Bennett counties).

ACERATES VIRIDIFLORA LINEARIS Gray
On sandy and dry prairies, fairly common; (Washabaugh county).

CUSCUTA CUSPIDATA Engelm.? Dodder.
Rare, parasitic on Ambrosia and legumes; (Bennett county).

CUSCUTA INDECORA Choisy? Pretty dodder.
Parasitic on various plants of the dry soils; (Washabaugh county).

GILIA LONGIFLORA (Torr.) Don. White flox.
Abundant on pure sand; (Bennett county).

HELIOTROPIUM SPATHULATUM Rydb. Heliotrope.
Abundant in deserted fields; (Washington county).

LITHOSPERMUM MANDANENSE Sprengl. Puccoon.
Common on the sand hills of Washington county.

VERBENA AMBROSIAEFOLIA Rydb. Showy Phlox-vervain.
Quite abundant on the plains throughout, especially along roads; (Washabaugh, Washington, Shannon counties).

HEDEOMA LONGIFLORA Rydb. Penneroyal.
Rather frequent on hillsides; (Washington county).

LYCOPUS COMMUNIS Bicknell. Water hoarhound
Universal on such banks of streams as have vegetation; (Washabaugh county). *Lycopus uniflorus* Michx.

SOLANUM INTERIOR Rydb. Western nightshade.
Common in shaded valleys in the sand hills; (Bennett county).

GERARDIA PAUPERCULA (Gray) Britton
Common along permanent streams, especially in the sand hills; (Bennett county).

PENTSTEMON ACUMINATUS Dougl.
Abundant on the plains; (Bennett county).

VERONICA XALAPENSIS H. B. K. Purslane speedwell.
In cultivated and wet places, infrequent; (Washabaugh county).

PLANTAGO SPINULOSA Dcne.
Infrequent on the prairies; (Washabaugh county).

GALIUM SUBBIFLORUM (Wiegand) Rydb. Small bed-straw.
Frequent along the margin of La Creek; (Bennett county).

AMBROSIA MEDIA Rydb. Sand ragweed.
Abundant on sand; (Shannon county).

ASTER LONGULUS Sheldon

Rare in the ravines; (Bennett county).

ASTER POLYCEPHALUS Rydb. Plains aster.

Very abundant and conspicuous in late August on the plains; (Washabaugh county).

BIDENS GLAUCESCENS Greene. Beggar's tick.

Common in bogs of the sand hills; (Bennett county).

BIDENS TRICHOSPERMA TENUILOBA Gray. False marsh marigold.

A pest along the Little White and La Creek; (Bennett county).

BOEBERA PAPPOSA (Vent.) Rydb. Fetid marigold.

Rare on flood plains; (Washington county).

CARDUUS FLODMANII Rydb.

Rare on the plains near Medicine Root; (Washington county)

CARDUUS NELSONII Pammel

On the sides of Washington county sand hills; rare.

CHRYSOPSIS FOLIOSA Nutt. Golden aster.

Abundant on the plains; (Washington county).

CHRYSOTHAMNUS GRAVEOLENS (Nutt.) Greene. Rabbit brush, rayless golden rod.

Highly characteristic of the bad lands; (Washington and Washabaugh counties).

ERIGERON BELLIDIASTRUM Nutt.

Rare in the sand hills of Washington county.

ERIGERON DIVERGENS T. & G.?

Tolerably common along roads; (Washabaugh county).

ERIGERON RAMOSUS (Walt.) B. S. P. Daisy fleabane.

Abundant on plains; (Washabaugh county).

EUPATORIUM BRUNERI Gray Joe Pye weed.

Plentiful along permanent streams; (Bennett county).

GUTIERREZIA DIVARICATA Nutt.

Rare in the bad lands on hillsides; (Washabaugh county).

HELIANTHUS LENTICULARIS Dougl. Large sunflower.

Common on the steppe; (Washabaugh county).

LACTUCA VIROSA L.

Rare on the flood plains of Bear creek; (Washabaugh county). *L. integrata* (Gren. & Godr.) A. Nelson.

RATIBIDA COLUMNARIS PULCHERRIMA (DC.) D. Don. Red cone flower.

Occasional on the plains; (Washabaugh county).

RUDBECKIA FLAVA Moore. Prairie black-eyed Susan.

Very abundant everywhere on the uplands; (Bennett county)

SENECIO RIDDELLII T. & G.

Abundant along old roads.

SOLIDAGO MOLLIS Bartl. Prairie goldenrod.

Abundant on the plains; (Bennett county).

SOLIDAGO PITCHERI Nutt.

Rare in woodlands; (Washington county).

SOLIDAGO TRINERVATA Greene

Rare on flats along streams; (Washabaugh county).

TARAXACUM ERYTHROSPERMUM Andrz. Red seeded dandelion.

Rare along Wounded Knee creek; (Shannon county).

TOWNSENDIA GRANDIFLORA Nutt.. Bad land blue aster.

Characteristic and abundant on loose clay of bad land slopes. (Washington county).

State University, Vermillion, South Dakota.

THE OAKS OF THE PACIFIC SLOPE—II

BY A. A. HELLER

THE BLUE OAK

QUERCUS DOUGLASII H. & A. Bot. Beech. 391. 1841.

This oak, a hill species, is readily recognized by the characteristic blue-green color of its foliage. At maturity it is a tree 20 to 50 feet high, with a well rounded crown and short trunk 1 to 2 feet in diameter. Trees growing under very favor-

Plate 9.

Quercus Douglasii. Stanford University, California.

able conditions are larger. The gray bark is made up of thin plates or flakes, with shallow intervening fissures. The leaves are very irregular, some nearly entire, while others are prominently lobed. They are rather small, 1 to 3 inches long, ½ to 2½ inches wide. The cup of the acorn is shallow, and the acorn itself is somewhat variable in shape. While perhaps most commonly shaped like the ones illustrated in figure 1, they may be slender with a pointed apex.

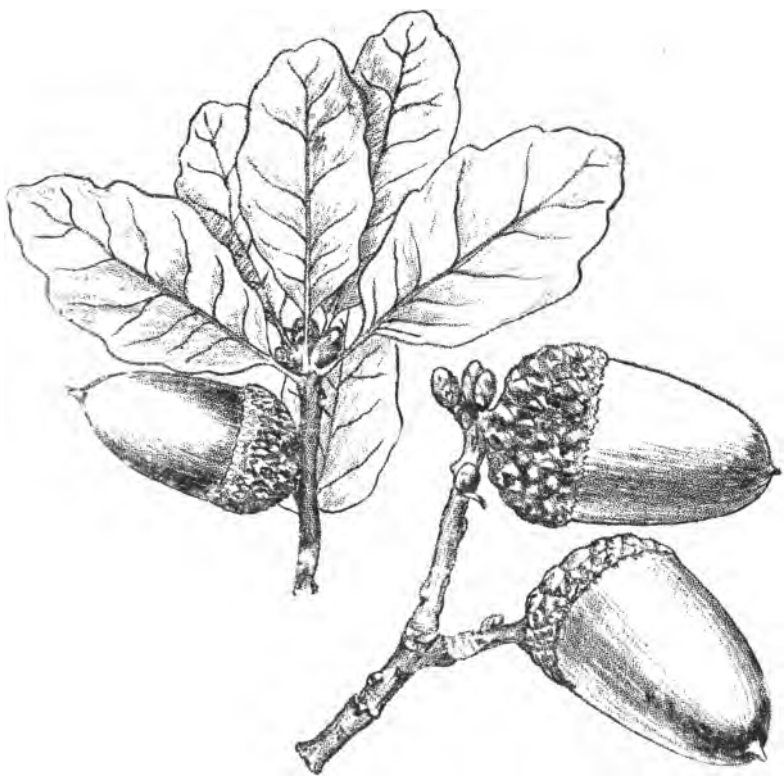

Figure 1. Quercus Douglasii

The tree is found in California only, its northern limit being about the same as that of *Q. lobata*, namely, the hills bordering the upper end of the Sacramento valley, but in the south it extends to the southern borders of the state. The most congenial conditions for growth are apparently in Monterey county,

where many trees of the largest size are frequent along the San Antonio and Naciemento rivers, according to Jepson, in Silva of California.

While scattered trees are found in the coast region, growing in company with *Q. agrifolia* and *Q. lobata* in places where the rainfall is comparatively heavy, and fog more or less frequent, it is found most abundantly on the dry hills about the interior valleys, where the summers are hot and dry. It is especially abundant on the hills of Butte county, where in places it is the dominant tree, but is frequently associated with *Q. Wislizeni*, the interior live oak, and the digger pine, *Pinus Sabiniana*.

The wood is heavy, specific gravity 0.89, but is brittle, warps and checks easily, and is used but little except for fuel. The sapwood is thick. Fence posts to a limited extent are made from it, and at one time it was used in the manufacture of wagon wheel parts.

Acorns are produced in abundance, and reproduction from this source is common. Coppice growth is also produced, but is less common. The tree grows slowly. Apart from its value as a source of fuel, this tree is of considerable importance as a ground cover for the dry slopes on which it is most plentiful.

TWO NEW SPECIES OF CARDUUS FROM COLORADO

By George E. Osterhout

Carduus modestus sp. nov.

A biennial or short lived perennial, 6 to 8dm. high, slightly arachnoid pubescent, branching above the middle into several slender branches, very leafy: the lower leaves oblanceolate, 1 to 2 dm. long, pinnately parted into numerous triangular divisions, these tipped with rather small spines; the upper smaller, lanceolate and less divided, all thin, whitish tomentose beneath, glabrate above, moderately decurrent on the stem, the clasping base expanded and prickly; heads subtended by a leafy bract, numerous and small, about 15mm. high, the bracts stout for the size of the head, somewhat woolly pubescent, the outermost short

Plate 10.

Quercus Douglasii. Hills near Oroville, California.

and flat, the second series prolonged into a stout spine, thickened upward and equaling the inner in length, the inner ones weaker and unarmed: flowers whitish: pappus brown and plumose.

Collected along Thompson river in the canyon just east of Estes Park, Larimer county, Colorado, August 23, 1912, no. *4803*. I suppose the relationship of this Carduus is with *C. americanus* (Gray) Greene, and *C. spathulatus* Osterhout, but the small heads and long thickened bracts, not at all fimbriate, separate it from these. The long bracts might suggest *C. griseus* Rydb., but *C. modestus* is a much more slender plant with smaller heads, and the long bracts are not flat as they are in *C. griseus*.

In his account of some hybrid thistles in Bull. Torr. Club **37**: 584, Dr. Rydberg made a plant which I collected here a hybrid of *C. griseus* and *C. laterifolius*, but I should say that the hybrid is rather of *C. modestus* and probably *C. americanus*, since it has the long stout bracts of *C. modestus*, but with some of them showing fimbriation.

Along Thomson river as it leaves Estes Park, and in the canyon near there, are a number of species of Carduus which are of interest to the student of these things because of the intermediate forms. Here occur *C. americanus* (Gray) Greene, *C. laterifolius* Osterhout, and the one here described, *C. modestus*. All of these appear to have hybridized, and possibly there are crosses of hybrid with hybrid; at any rate the forms are perplexing and difficult of classification.

Carduus acuatus sp. nov.

Seemingly a short-lived perennial 8 dm. or more high, considerably arachnoid pubescent, rather stout, leafy to the ends of the branches: leaves linear in outline, acuminate, divided about half way to the midrib, the lobes again divided into two or three acuminate parts prolonged into stout, sharp spines; lower leaves 1 to 2 dm. long, becoming smaller upward, all armed with the uncommonly stout needle-like spines, the under surface matted woolly pubescent, the upper side green but considerably arach-

noid woolly: heads medium in size, 15 to 20 mm. wide, 25 mm. high: bracts somewhat woolly pubescent, especially on the edges, glandular ridged, in about 5 series, the two innermost series innocuous, but much prolonged into slender curled tips, the others armed with long, slender spines: flowers whitish: pappus white, about 2 cm. long, plumose.

Collected near the banks of the North Fork of the Gunnison river at Paonia, Delta county, Colorado, July 23. 1911, no. *4612*. This Carduus is remarkable for its stout spines, and I know of no species in Colorado which equals it in this respect. Its relationship is probably with *C. ochrocentrus* (Gray) Greene, but the spines are even stouter than they are in that species, the divisions of the leaves are fewer, it is more branched, and the heads are much smaller.

Windsor, Colorado.

FRAXINUS OREGANA Nutt.

Swamps and margins of streams, Coaledo, *4965*, August 26, 1912.

GENTIANA SCEPTRUM Griseb.

Sand dune meadows, *4690*, August 19, 1911; swamps of Empire and Coos Head; *Hayden 127*.

CONVOLVULUS SOLDANELLA L.

Sandy shores of bay at Big Creek, *5035*, September 15, 1912. *Hayden 125*.

CUSCUTA SQUAMIGERA (Engelm.) Piper

On Salicornia, sand dune meadows, *4683*, August 19, 1911.

SCROPHULARIA CALIFORNICA Cham.

Marshfield; *4757*, September, 1911. *Hayden 124*.

VERONICA AMERICANA Schwein.

Swampy places and springs, Marshfield; *4789*, September 5, 1911.

VERONICA SCUTELLATA L.

Springy places near Marshfield, *4711*, August, 1911.

DIGITALIS PURPUREA L.

Both the white and the purple flowered forms of this species are abundantly established everywhere; *4716*, August, 1911.

MIMULUS DENTATUS Nutt.

Damp woods near Marshfield, *4708*, August 21, 1911.

MIMULUS MOSCHATUS Dougl.

Head of Coos river, *4814*, September 3, 1911.

MIMULUS LANGSDORFII Donn

Sand dune meadows, *4689*, August 19, 1911; near Marshfield, *4775*, September, 1911.

MIMULUS (specimens numbered *4808*, *4826*, *4966*, *5024*) undetermined, and probably represent more than one species. August and September is too late to collect satisfactory material of this genus.

ORTHOCARPUS CASTILLEOIDES Benth.

Sand dune meadows, *4694*, *4696*, *4701*, August, 1911.

PLANTAGO MARITIMA L.

Sand dune meadows, *4698*, August 19, 1911.

PLANTAGO PURSHII R. & S.

Sand dunes and shores, *5018*, September 8, 1911. *Hayden 224.*

GALIUM TRIFLORUM Michx.

Woods at head of Coos river, *4957*, September 1, 1911. *Hayden 216.*

SYMPHORICARPOS RACEMOSUS Michx.

Common on rocky banks at head of Coos river, *4830*, September 3, 1911.

LONICERA HISPIDULA Dougl.

Common in thickets and margins of woods, Marshfield, *4724*, August, 1911; *4955*, August 20, 1912.

LONICERA INVOLUCRATA Banks. (*Distegia Ledebourii* (Esch.) Greene)

Common along the edges of swamps and sloughs and on low grounds near the sea shore; Marshfield, *4720*, August, 1911. *Hayden 240.* A single specimen near the mouth of Coos river measured four inches in diameter and ten feet in height.

LONICERA CAPRIFOLIUM L.

Well established in several places, Coos City, *4998*, September 2, 1912.

SAMBUCUS CALLICARPA Greene

Marshfield, *4679*, August, 1911.

SAMBUCUS GLAUCA Nutt. occurs at a few places, but was not collected.

HIERACIUM ALBIFLORUM Hook.

Common at the head of Coos river, *4986*, September 1, 1912. *Hayden 246.*

GAERTNERIA BIPINNATIFIDA (Nutt.) Kuntze

Sand dunes, *5027*, September 8, 1912.

EUTHAMIA OCCIDENTALIS Nutt.

Rocks at the head of Coos river, *4824*, September 3, 1911.

ERIGERON SPECIOSUS DC.

On the fog swept cliffs of Coos Head, *5029*, September 15, 1912. *Hayden 135*.

ASTER DOUGLASII Lindl.

Sand dune meadows, *4769*, August 19, 1911; swamps of Coos Head, *4999*, September 15, 1912.

ASTER, undetermined, sand dune marshes, *5029*, September, 1912.

SOLIDAGO, undetermined, swamps of Coos Head, *5034*, September 15, 1912.

TANACETUM HURONENSE Nutt.

Common on the sand dunes, *5002*, September 8, 1912. *Hayden 223*. I believe this has been more recently renamed *T. camphoratum* by Lessing.

ANAPHALIS MARGARITACEA OCCIDENTALIS Greene

Near Marshfield, *5015*, August 20, 1912.

SERICOCARPUS RIGIDUS Lindl.

Rocks along streams at head of Coos river, *4975*, September 1, 1912.

ADENOCAULON BICOLOR Hook.

Woods near Marshfield, common, *4844*, September, 1911.

BACCHARIS PILULARIS DC.

Common on margins of salt marshes, Marshfield, *4992*, September 1, 1912.

State Botanist's Office, Education Building, Albany, N. Y.

TO THE READERS OF MUHLENBERGIA

Owing to pressure of field work during the summer, as well as delay incident to becoming established in a new place of residence, mailing at pound rates had to be discontinued. Hereafter no attempt will be made to issue this journal as a monthly, nor will twelve numbers constitute a volume. The present volume will contain the usual number of pages, about 150. The time of completion will depend upon the promptness of contributors or upon my own leisure for the preparation of articles.

Revisions of genera, descriptions of new plants, and better still, the clearing up of doubtful points about old ones will always be welcome.

CATALOG OF NORTH AMERICAN PLANTS

This work is being pushed along rapidly, and I hope to complete it in April. Several valuable features not in former editions are found in this one, as family name at the top of the page, and citation of publication of families and genera. The book will be cloth bound, price $1.50 postpaid. Your subscription is solicited now, but payment may be made when the book is delivered. Your name now will save expense later, as the book may be bound in the east, and mailing from the bindery will save freight charges.

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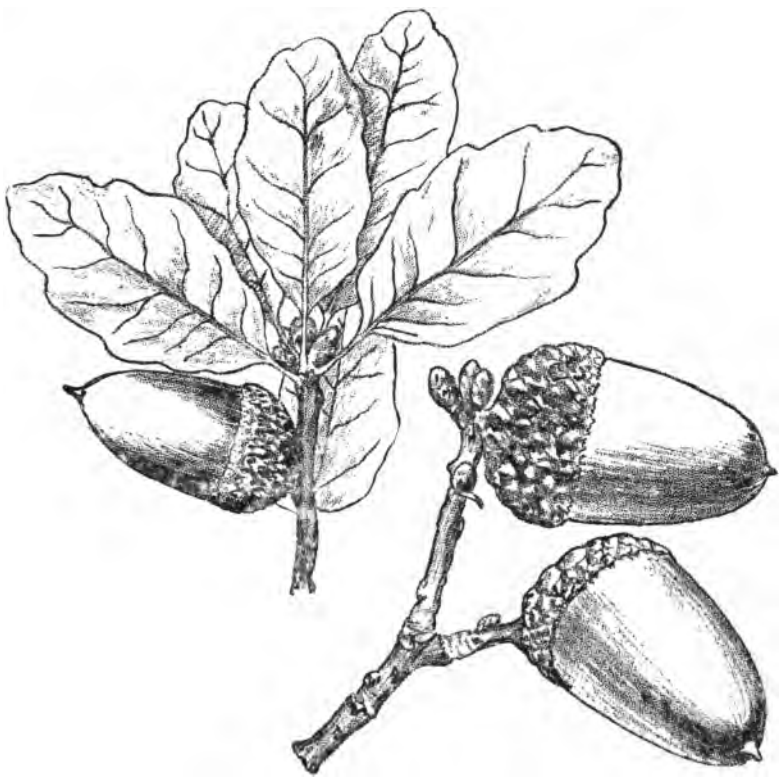

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Box 853
Chico, California

Volume 9 December 3, 1914

MUHLENBERGIA

FLORA OF WHATCOM COUNTY, WASHINGTON—I.

By Walter L. C. Muenscher

During the last five years, 1910 to 1914, it has been the writer's pleasure to collect, from time to time, plants from various regions of Whatcom county, Washington. The author's collection consists of considerably over 400 species and varieties of plants. To this list are added a number of plants which the writer did not collect, but which were obtained in this region by other botanists. Among these collections those of Miss Annie L. Fallis, instructor in botany in the Bellingham high school, and the collections of the botanists which are reported in Piper's Flora of Washington, are to be given special mention. In each case where a plant is included in the list, the collector's name is given, unless it was collected by the writer.

The specimens were determined by the writer, and were placed in his private herbarium. Doubtful species were compared with herbarium specimens, either in the herbarium of the State College of Washington at Pullman, or in the herbarium of the Puget Sound Marine Station at Friday Harbor, Washington. All available literature on the northwest flora was used, but in general the nomenclature of Piper's Flora of Washington was followed. Many of the common names were taken from "Frye and Rigg's Northwest Flora." The writer extends thanks to the above mentioned institutions and authors for their aid in this work.

Whatcom county is located in the extreme northwestern part of Washington. It stretches over about 100 miles from its extreme western to its extreme eastern boundaries, and runs

about 25 miles south of the British Columbia line, making an approximate area of 2300 square miles.

With the exception of Lummi and Eliza islands, and a few smaller islands, the county is all on the mainland. With Puget Sound for its western boundary, the county starts at sea level and rises to its highest point, Mt. Baker, with an elevation of almost 11000 feet above sea level. The westerly one-third of the county is composed of valleys and comparatively level uplands, while the eastern portion, except for a few narrow river valleys, is covered with rugged mountains.

The county is drained to the west by the Nooksack river and its tributaries; to the south by the Skagit and Baker rivers, and to the north by the Chillawack river. The county contains many lakes which are of glacial origin, many of which are filling up with peat bogs. The larger lakes where collections were made are given in order of their size, as follows: Whatcom, Baker, Weiser, Silver, Padden, Green, Fountain and Panghorn.

The flora of the western portion of the county is in the Humid Transition zone, while the greater portion of the eastern part of the region comes in the Canadian and Hudsonian zones. The higher snow capped peaks have a flora belonging distinctly to the Arctic zone.

The following list records a total of 462 vascular plants which are known to grow without cultivation within the boundaries of Whatcom county, Washington. The list consists of 17 pteridophytes, 14 gymnosperms, 100 monocotyledons, 391 dicotyledons.

PTERIDOPHYTA

POLYPODIACEAE

POLYPODIUM OCCIDENTALE Hook. Licorice fern.
Common on the trunks of trees.

POLYPODIUM SCOULERI Hook. & Grev.
Infrequent on rocks along the shore line

PHEGOPTERIS DRYOPTERIS (L.) Fee. Beech fern.
Moist woods near Baker lake, otherwise uncommon.

ADIANTUM PEDATUM ALEUTICUM Rupr. Maiden Hair fern.
Common on moist, shady slopes.

PTERIDIUM AQUILINUM PUBESCENS Underw. Brake fern.
Very abundant on cut over upland soil.

POLYSTICHUM MUNITUM (Kaulf.) Presl. Sword fern.
Common in upland forests.

STRUTHIOPTERIS SPICANT (L.) Weiss. Deer fern.
Common in the foothills, otherwise rare.

ASPLENIUM VIRIDE Huds. Spleenwort.
In woods between Mt. Baker and Baker lake.

ATHYRIUM CYCLOSORUM Rupr. Soft fern.
Very abundant in rich, moist forests.

DRYOPTERIS SPINULOSA DILATATA (Hoffm.) Underw. Wood fern
Samish lake, *Suksdorf 1029*.

OPHIOGLOSSACEAE

BOTRYCHIUM SILAIFOLIUM Presl. Grape fern.
Rare in a peat marsh on Muenscher's farm.

CALAMOPHYTA

EQUISETACEAE

EQUISETUM ARVENSE L. Horse tail.
Common and widely distributed.

EQUISETUM HYEMALE L. Scouring rush.
Uncommon in most protected copses.

EQUISETUM FLUVIATILE L. Ten Mile.
Common in wet ground.

LEPIDOPHYTA

LYCOPODIACEAE

LYCOPODIUM CLAVATUM L. Club moss.
Uncommon in woods of foothills, Nooksack mountain.

LYCOPODIUM SELAGO L.
Rare, east slope of Mt. Baker.

SELAGINELLACEAE

SELAGINELLA RUPESTRIS L.
On exposed rocky bluffs, south of Bellingham.

STROBILOPHYTA

TAXACEAE

TAXUS BREVIFOLIA Nutt. Western yew.

Common along Baker river and Whatcom falls, otherwise rare

PINACEAE

JUNIPERUS COMMUNIS SIBIRICA (Burgsd.) Rydb. Juniper.

Rare, summit of Lookout mountain; near timber line of Mt. Baker.

JUNIPERUS SCOPULORUM Sargent. Rocky mountain juniper.

Along the rocky sea shores south of Bellingham; Lummi island.

CHAMAECYPARIS NOOTKATENSIS (Lamb.) Spach. Alaska cedar.

Common on the higher mountains, Mt. Baker, Lookout mountain.

THUJA PLICATA Donn. Giant cedar.

Common in our forests.

PINUS MONTICOLA Dougl. Western white pine.

Along north fork of Nooksack river; near Maple Falls; Lookout mountain.

PINUS CONTORTA Dougl. Shore pine.

Common in peat bogs and along the shore line.

ABIES NOBILIS Lindl. Alpine fir.

In the alpine forests of Mt. Baker.

ABIES AMABILIS Dougl. Lovely fir.

Subalpine forests on Lookout mountain.

ABIES GRANDIS Lindl. White fir.

Common in upland forests.

PSEUDOTSUGA TAXIFOLIA (Lamb.) Britton. Red fir.

The commonest tree of the region.

TSUGA MERTENSIANA (Bong.) Carr. Black hemlock.

Alpine forests of the higher mountains; Lookout mountain.

TSUGA HETEROPHYLLA (Raf.) Sargent. Western hemlock.

Common in upland forests.

PICEA SITCHENSIS (Bong.) Traut. & Meyer. Sitka spruce.

Common in the lowlands.

ANTHOPHYTA—MONOCOTYLEDONEAE

TYPHACEAE

TYPHA LATIFOLIA L. Cat tail.

Common along the margins of lakes.

SPARGANIACEAE

SPARGANIUM SIMPLEX Huds. Bur reed.

In wet places near Lynden.

POTAMOGETONACEAE

POTAMOGETON AMPLIFOLIUS Tuck. Pond weed.

Infrequent in shallow ponds.

POTAMOGETON PERFOLIATUS RICHARDSONII Bennett.

In Whatcom creek.

POTAMOGETON ZOSTERAFOLIUS Schum.

Whatcom county, *Suksdorf.*

POTAMOGETON NUTTALLII C. & S.

Ponds near Bellingham.

NAIADACEAE

ZOSTERA MARINA L. Eelgrass.

Abundant at low tide along the sea shore, Birch bay.

ALISMACEAE

ALISMA PLANTAGO-AQUATICA L. Water plantain.

Frequently found in shallow ponds.

SAGITTARIA LATIFOLIA Willd. Arrow head.

Infrequent along margins of ponds.

POACEAE

PANICUM CRUS-GALLI L. Barnyard grass

Sparsely introduced.

CHAETOCHLOA VIRIDIS (L.) Scribn. Green foxtail.

Introduced in fields, Ten Mile.

MUHLENBERGIA RACEMOSA Michx.

Sumas Prairie, *Lyall*, in 1858.

ALOPECURUS GENICULATUS FULVUS Smith. Water foxtail grass.

Common along margin of Green lake.

PHLEUM PRATENSE L. Timothy.

Escaped from cultivation.

CALAMAGROSTIS LANGSDORFII LACTEA (Beal) Kearney
Near Mt. Baker, *Suksdorf 1022.*

CALAMAGROSTIS CRASSIGLUMIS Thurber
Infrequent.

AGROSTIS ALBA L. Red top.
Common, introduced.

AGROSTIS EXARATA Trin.
Infrequent near Bellingham bay.

HOLCUS LANATUS L. Mesquite grass.
Very abundant in meadows.

AIRA CARYOPHYLLEA L. Silvery hair grass.
Abundant on dry, sandy soil, Ten Mile.

AVENA FATUA GLABRATA Petermann. Wild oats.
Common in grain fields.

DESCHAMPSIA CAESPITOSA (L.) Beauv. Tufted hair grass.
Common in low ground.

DESCHAMPSIA ELONGATA (Hook.) Munro. Slender hair grass.
Infrequent in low ground.

KOELERIA CRISTATA (L.) Pers. June grass.
Infrequent near Chuckamut bay, Lummi island.

MELICA SMITHII (Porter) Vasey
Infrequent in low, wet ground.

DACTYLIS GLOMERATA L. Orchard grass.
Introduced, infrequent.

POA COMPRESSA L. Canada blue grass.
Introduced, not common.

POA PRATENSIS L. Kentucky blue grass.
Introduced and widely distributed.

POA TRIFLORA Gilib.
South Bellingham; Birch bay.

FESTUCA OVINA SUPINA (Schw.) Hack. Sheep fescue.
Infrequent in the mountains.

FESTUCA OCCIDENTALIS Hook. Western fescue.
Uncommon.

PUCCINELLIA ANGUSTATA (R. Br.) Nash. Spear grass.
Whatcom county, *Suksdorf.*

BROMUS CARINATUS H. & A. Brome grass.
Frequent in the woods.

BROMUS MARGINATUS Nees
Infrequent near Lynden.

BROMUS HORDEACEUS L.
Introduced in dry, waste land.

LOLIUM TEMULENTUM L. Darnel.
Introduced about Bellingham.

LOLIUM PERENNE L. Perennial rye grass.
Introduced into meadows and fields.

HORDEUM JUBATUM L. Squirrel tail grass.
Sparingly introduced.

HORDEUM NODOSUM L. Wild barley.
Introduced along railroad tracks.

HORDEUM MURINUM L. Wall barley.
Sparingly introduced, Bellingham.

ELYMUS ARENARIUS L. Sea lyme grass.
Along the sea shore, Chuckamut bay, Lummi point.

ELYMUS GLAUCUS Buckley. Smooth wild rye.
Along Chuckamut bay.

CYPERACEGE

SCIRPUS OCCIDENTALIS (Wats.) Chase. Tule.
Common along the margin of lakes.

SCIRPUS MICROCARPUS Presl
Infrequent along margins of lakes and ponds.

CYPERACEAE

ERIOPHORUM CHAMISSONIS C. A. Meyer. Cotton grass.
Infrequent in peat bogs, Weiser lake.

ERIOPHORUM GRACILE Roth
Peat bogs at North Prairie near B. C. boundary line.

ELEOCHARIS PALUSTRIS (L.) R. & S. Spike rush.
Common about ponds.

RHYNCHOSPORA ALBA (L.) Vahl. White beak rush.
Whatcom county, *Suksdorf.*

CAREX ARCTA Boott. Sedge.
Frequent in the foothills.

CAREX FLAVA RECTEROSTRATA Bailey
Lake Padden, *Suksdorf 1017.*

CAREX LAEVICULMIS Meinsch.
Infrequent.

CAREX LENTICULARIS Michx.
Sumas Prairie, *Lyall*, in 1858.

CAREX LEPTALEA Wahl.
Common in low ground.

CAREX PAUCIFLORA Lightf.
Common in peat bogs.

Five carices as yet undetermined have been collected in the county, one at Panghorn lake, one on Mt. Baker, two on Lookout mountain and one at Green lake.

ARACEAE

LYSICHITON CAMTSCHATCENSE (L.) Schott. Skunk cabbage.
Very abundant in low, wet ground.

LEMNACEAE

LEMNA TRISULCA L. Duckweed.
Common, floating on lakes and ponds.

JUNCACEAE

JUNCUS BALTICUS Willd. Baltic rush.
Very common along margins of ponds.

JUNCUS EFFUSUS L. Hummock rush.
Frequent in low ground.

JUNCUS BUFONIUS L. Toad rush.
Abundant in dried up ponds and ditches.

JUNCUS COVILLEI Piper
Frequent in wet ground.

JUNCUS ENSIFOLIUS Wiks. Sword rush.
Very common in wet ground and along ditches.

JUNCUS RICHARDSONIANUS Schult.
Whatcom county, *Gardner 417*.

JUNCOIDES PARVIFLORUM (Ehrh.) Coville. Wood rush.
Infrequent in woods in the mountains.

JUNCOIDES CAMPESTRE (L.) Kuntze. Field wood rush.
Infrequent in the woods, Ten Mile.

LILIACEAE

ALLIUM CERNUUM Roth. Wild onion.
Along the shore line, Bellingham bay; Birch bay.

HOOKERA CORONARIA Salisb.
Sandy soil along the sea shore.

LILIUM PARVIFLORUM (Hook.) Holzinger. Lily.
Rare in open woods, Lynden; Whatcom creek.

FRITILLARIA LANCEOLATA Pursh. Checkered lily.
Lummi island and near Chuckamut bay, *Annie L. Fallis.*

ERYTHRONIUM MONTANUM Wats. Adder's tongue.
Rare on Nooksack mountain.

ERYTHRONIUM GIGANTEUM Lindl. Adder's tongue.
Foothills about Bellingham, *Annie L. Fallis.*

LLOYDIA SEROTINA (L.) Sweet. White flowering grass.
In woods near Mt. Baker.

MELANTHACEAE

VERATRUM VIRIDE Ait. Green hellebore.
Along streams and springy places in the higher mountains.

TOFIELDIA INTERMEDIA Rydb.
Infrequent in the mountains.

ZYGADENUS VENENOSUS Wats. Death camas.
Uncommon on dry soil along the shore.

CONVALLARIACEAE

TRILLIUM OVATUM Pursh. Wake robin.
Common in deciduous upland forests.

CLINTONIA UNIFLORA (Schult.) Kunth. Clintonia.
Common in moist woods, Mt. Baker.

VAGNERA SESSILIFOLIA (Nutt.) Greene. False Solomon's seal.
Shady places along streams.

VAGNERA AMPLEXICAULIS (Nutt.) Greene. False Solomon's seal
Frequent in woods along Baker river.

UNIFOLIUM BIFOLIUM KAMTSCHATICUM (Gmel.) Piper. Wild lily of the valley.
Locally abundant in open, wet woods.

DISPORUM OREGANUM (Wats.) Benth. & Hook. Fairy bells.
Infrequent in upland forests.

DISPORUM MAJUS (Hook.) Britton. Fairy bells.
In woods about Baker lake.

STREPTOPUS AMPLEXIFOLIUS (L.) DC. Twisted stalk.
Along streams in the mountains, otherwise rare.

KRUHSEA STREPTOPOIDES (Ledeb.) Kearney
Rare in woods north of Baker lake.

ASPARAGUS OFFICINALIS L. Asparagus.
Sparingly escaped from cultivation, Lynden.

IRIDACEAE

HYDASTYLUS BOREALIS Bicknell. Yellow star grass.
Infrequent. The type was collected in Whatcom county by Suksdorf.

OLSYNIUM GRANDIFLORUM (Dougl.) Raf. Purple star grass.
Collected near Lynden by Minnie Worttsen.

ORCHIDACEAE

CORALLORHIZA MULTIFLORA Nutt. Coral root.
In deep woods of the foothills; rare.

CYTHEREA BULBOSA (L.) House. Calypso.
Woods near Nooksack mountain; Sea home hill, *Annie L. Fallis.*

OPHRYS CAURINA (Piper) Rydb. Tway blade.
Woods ou east slope of Mt. Baker, otherwise rare.

PERAMIUM DECIPIENS (Hook.) Piper. Rattlesnake plantain.
Common in coniferous woods.

LIMNORCHIS LEUCOSTACHYS (Lindl.) Rydb. Orchis.
Rare in wet places.

LIMNORCHIS STRICTA (Lindl.) Rydb.
Rare in springy places in the foothills.

LYSIAS ORBICULATA (Pursh) Rydb.
Rare on decaying logs in damp woods.

PIPERIA UNALASCHENSIS (Spreng.) Rydb. Orchis.
Infrequent in the foothills.

IBIDIUM ROMANZOFFIANUM (Cham.) House
Swampy, open places along the shore of Silver lake, Goshen

DICOTYLEDONEAE

SALICACEAE

SALIX SCOULERIANA Barratt. Scouler's willow.
Common and widely distributed.

SALIX MYRTILLOIDES L. Bog willow.
In peat bogs.

SALIX CORDATA Muhl.
Infrequent.

SALIX SITCHENSIS Sanson. Alpine willow.
Frequent in the mountains.

POPULUS TREMULOIDES Michx. Quaking aspen.
Infrequent, Ten Mile; Wahl.

POPULUS TRICHOCARPA T. & G. Cottonwood.
Common along Nooksack river valley.

MYRICACEAE

MYRICA GALE L. Sweet gale.
Peat bogs, Panghorn lake; Green lake.

BETULACEAE

CORYLUS CALIFORNICA (A. DC.) Rose. Hazel.
Common in woods.

BETULA OCCIDENTALIS Hook. Birch.
Common in woods.

BETULA GLANDULOSA Michx. Dwarf birch.
In sphagnum bogs along Four mile creek; Panghorn lake.

ALNUS OREGANA Nutt. Red alder.
A common tree in the bottom lands.

ALNUS SINUATA (Regel) Rydb. Alder.
In the foothills, infrequent.

FAGACEAE

QUERCUS GRRRYANA Dougl. Scrub oak.
Dry, exposed places at South Bellingham, *Annie L. Fallis.*

URTICACEAE

URTICA LYALLI Wats. Nettle.
Widely distributed in rich soil.

HUMULUS LUPULUS L. Hop.
Introduced in low ground, Ten Mile.

ARISTOLOCHIACEAE

ASARUM CAUDATUM Lindl. Wild ginger.
Along streams in the mountains, Lookout mountain.

POLYGONACEAE

RUMEX ACETOSELLA L. Sheep sorrel.
A common field and garden weed.

RUMEX CRISPUS L. Yellow dock.
Common in fields, introduced.

RUMEX OCCIDENTALIS Wats. Western dock.
Common in low, wet ground.

RUMEX CONGLOMERATUS Murr. Clustered dock.
Sparingly introduced.

RUMEX OBTUSIFOLIUS L. Bitter dock.
Rare, introduced about Bellingham.

POLYGONUM CONVOLVULUS L. Bindweed.
A very common weed in fields.

POLYGONUM AVICULARE L. Doorweed.
Common along paths and in yards.

POLYGONUM SPERGULARIAEFORME Meisner
Uncommon along Bellingham bay.

POLYGONUM BISTORTOIDES Pursh. Alpine smartweed.
Abundant in the meadows of Mt. Baker.

POLYGONUM AMPHIBIUM L. Water smartweed.
Rare, growing in ponds.

POLYGONUM LAPATHIFOLIUM L. Smartweed.
Infrequent.

POLYGONUM PERSICARIA L. Smartweed.
Very common in peat ground pastures.

CHENOPODIACEAE

SALICORNIA AMBIGUA Michx. Saltwort.
Common just above the high tide mark, Birch bay; Lummi Point.

ATRIPLEX PATULA LITTORALIS Gray,
Birch bay; Chuckanut bay.

CHENOPODIUM ALBUM L. Lamb's quarter.
A very common garden weed.

AMARANTHACEAE

AMARANTHUS RETROFLEXUS L. Pigweed.
A very common garden weed.

PORTULACACEAE

CLAYTONIA PARVIFLORA Dougl. Miners lettuce.
Common in the woods.

CLAYTONIA SIBIRICA L. Spring beauty.
Not uncommon in shady places.

CLAYTONIA ASARIFOLIA Bong.
Uncommon in springy places in the mountains.

CLAYTONIA LANCEOLATA Pursh
Infrequent near Baker lake.

SILENACEAE

SILENE ANGLICA L. Catchfly.
Infrequent near Bellingham.

SILENE NOCTIFLORA L. Night blooming catchfly.
An uncommon weed.

LYCHNIS CORONARIA Desr. Mullein pink.
Escaped from cultivation, Ten Mile.

CERASTIUM ARVENSE L. Mouse ear chickweed.
A common weed.

CERASTIUM VULGATUM L. Mouse ear.
Infrequent in shady places.

ALSINE MEDIA L. Chickweed.

Common in gardens.

ALSINE BOREALIS (Bigel.) Britton. Northern chickweed.

Not uncommon in wet, waste places.

ALSINE CRISPA C. & S.

Semiahoo bay, *Lyall.*

AMMODENIA PEPLOIDES (L.) Rupr.

Bellingham bay, *Suksdorf.*

ARENARIA SAJANENSIS Willd. Sandwort.

Near Mt. Baker, *Suksdorf.*

ARENARIA SERPYLLIFOLIA L. Sandwort.

In woods.

SPERGULA ARVENSIS L. Spurry.

Common in gardens and grain fields.

TISSA RUBRA (L.) Britton. Pink sand spurry.

Shore of Baker lake.

TISSA MARINA (L.) Britton.

Along the seashore, Gooseberry point.

TISSA MACROTHECA (Hornem.) Britton.

Along saline shores, Bellingham; Blaine.

NYMPHAEACEAE

NYMPHAEA POLYSEPALA (Engelm.) Greene. Yellow pond lily.

Common on margins of lakes and ponds, throughout Panghorn lake.

CERATOPHYLLACEAE

CERATOPHYLLUM DEMERSUM L. Hornwort.

Shallow water, Fountain lake; Silver lake.

RANUNCULACEAE

BATRACHIUM AQUATILE PANTOTHRIX (Brot.) Piper. Water crowfoot.

Not common in ponds.

RANUNCULUS PURSHII Richards. Buttercup.

Wet places about Bellingham.

RANUNCULUS FLAMMULA REPTANS (L.) Schlecht.

Abundant on the sandy beach of Padden lake.

RANUNCULUS REPENS L.

Locally abundant in wet pastures near Ten Mile.

RANUNCULUS BONGARDII GREENEI (Howell) Piper

Infrequent in shady places.

RANUNCULUS SCELERATUS L.

Frequent in low ground.

RANUNCULUS PENNSYLVANICUS L.

McCloud lake; Green lake, *Suksdorf 2213*.

ACTAEA SPICATA ARGUTA (Nutt.) Torr. Baneberry.

Rare in upland forests.

AQUILEGIA FORMOSA Fisch. Columbine.

Uncommon in open places on uplands.

BERBERIDACEAE

BERBERIS NERVOSA Pursh. Oregon grape.

Common in upland forests.

BERBERIS AQUIFOLIUM Pursh. Shiny Oregon grape.

Common in coniferous upland woods.

ACHLYS TRIPHYLLA (Smith) DC. Vanilla leaf, Sweet in death.

Common in open forests.

PAPAVERACEAE

ESCHSCHOLTZIA CALIFORNICA Cham. California poppy.

Sparingly escaped from cultivation, Lynden.

BIKUKULLA FORMOSA (Andr.) Coville. Bleeding heart.

Common in open places and burnt over areas.

BRASSICACEAE

RORIPA CURVISILIQUA (Hook.) Bessey. Nasturtium.

Frequent in low, wet places.

RORIPA NASTURTIUM (L.) Rusby. Nasturtium.

Infrequent in wet places.

DRABA STENOLOBA Ledeb.

Mt. Baker, *Flett 851*.

DRABA LONCHOCARPA Rydb.

North of Baker lake.

ARABIS LYRATA OCCIDENTALIS Wats. Rock cress.

Nooksack river near Mt. Baker, *Suksdorf 1999*.

THELYPODIUM LASIOPHYLLUM (H. & A.) Greene
Whatcom county, *Suksdorf 953*.

BRASSICA NIGRA (L.) Koch. Black mustard.
Introduced into fields.

BRASSICA CAMPESTRIS L. Turnip.
Sparingly introduced.

BRASSICA ARVENSIS (L.) B. S. P. Wild mustard-charlock.
Introduced into fields.

SISYMBRIUM OFFICINALE (L.) Scop. Hedge mustard.
A very common weed.

SISYMBRIUM ALTISSIMUM L. Jim Hill mustard.
Rare, introduced about Bellingham.

SISYMBRIUM SOPHIA L.
Along roadsides between Bellingham and Goshen.

SUBULARIA AQUATICA L.
Lake Whatcom, *Suksdorf*.

CAPSELLA BURSA-PASTORIS (L.) Medic. Shepherd's purse.
A very common weed.

LEPIDIUM MENZIESII DC. Pepper grass.
Infrequent, Birch bay; Bellingham bay.

RAPHANUS SATIVUS L. Radish.
Escaped from cultivation.

RAPHANUS RAPHANISTRUM L. Wild radish.
Common in fields.

DROSERACEAE

DROSERA ROTUNDIFOLIA L. Sundew.
Peat bogs, Fountain lake.

CRASSULACEAE

SEDUM DIVERGENS Wats. Stonecrop.
Mountains near Baker lake.

SEDUM SPATHULIFOLIUM Hook.
Dry, rocky places near Chuckanut bay.

SEDUM STENOPETALUM Pursh
Infrequent, Nooksack mountains.

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MUHLENBERGIA

DECEMBER 26, 1914

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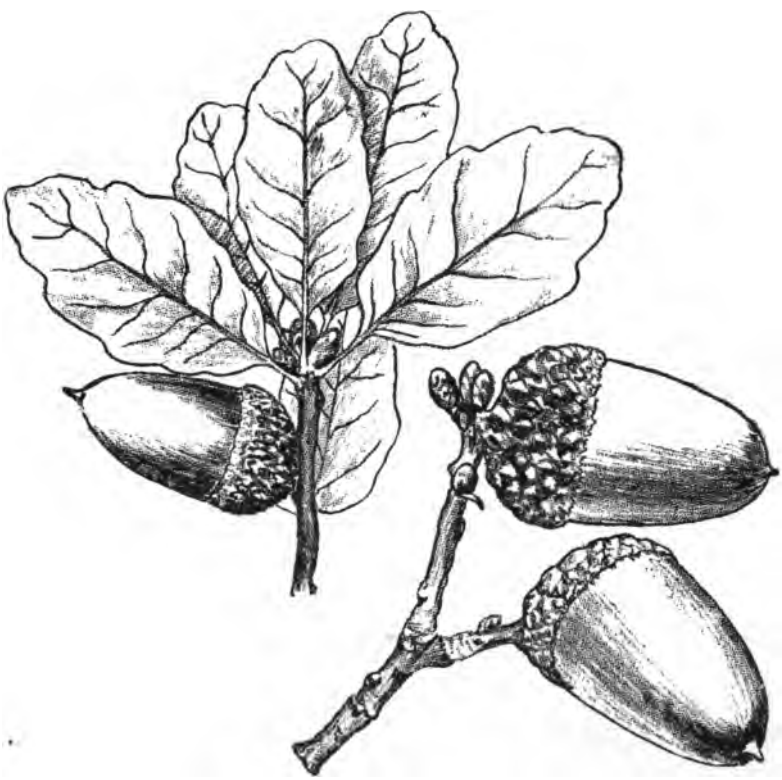

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Box 853
Chico, California

Volume 9 December 26, 1914

MUHLENBERGIA

FLORA OF WHATCOM COUNTY, WASHINGTON—II.

By Walter L. C. Muenscher

Crassulaceae

Gormania oregana (Nutt.) Britton

In the foothills, not uncommon.

Saxifragaceae

Saxifraga adscendens L. Saxifrage.

Lookout mountain, not uncommon.

Saxifraga Marshallii Greene

On the higher mountains.

Tiarella unifoliata Hook. Coolwort.

Lookout mountain.

Mitella trifida Graham. Bishop's cap.

On the higher mountains.

Heuchera micrantha Dougl. Alum root.

Common in woods.

Heuchera cylindrica Dougl.

Sumas Prairie, *Lyall* in 1858.

Parnassia fimbriata Koenig. Grass of Parnassus.

Springy places near the summit of Lookout mountain.

Grossulariaceae

Ribes divaricatum Dougl. Gooseberry.

Common in lowlands.

Ribes sanguineum Pursh. Red flowered currant.

Common in open woods.

Ribes lacustre (Pers.) Poir. Swamp gooseberry.

Common in moist ground.

RIBES BRACTEOSUM Dougl. Stink currant.
Along streams; Baker river valley.

RIBES CILIOSUM Howell. Wild red currant.
Found only along Baker river 12 miles above Concrete.

HYDRANGEACEAE

PHILADELPHUS GORDONIANUS Lindl. Syringa.
Infrequent in open, upland waods.

ROSACEAE

OPULASTER OPULIFOLIUS (L.) Kuntze Ninebark.
Uncommon along streams.

LUTKEA PECTINATA (Pursh) Kuntze. Partridge foot.
Very uncommon near the timber line of Mt. Baker.

SCHIZONOTUS DISCOLOR (Pursh) Raf. Ocean spray.
Common along open woods.

SPIRAEA DOUGLASII Hook. Hard hack.
Common in peat ground.

SPIRAEA DENSIFLORA Nutt.
On the higher mountains.

RUBUS PARVIFLORUS Nutt. Thimble berry.
Vern common in open woods.

RUBUS SPECTABILIS Pursh. Salmon berry.
Common along streams and in low ground.

RUBUS LEUCODERMIS Dougl. Black cap
Common on burnt over areas.

RUBUS MACROPETALUS Dougl. Blackberry-dewberry.
Very common on burned over areas.

RUBUS LACINIATUS Willd. Evergreen blackberry.
Escaped from cultivation.

RUBUS PEDATUS Smith.
Lookout mountain; Baker lake; common.

ARUNCUS ARUNCUS (L.) Karst. Goatsbeard.
Common along streams in the foothills.

ROSA GYMNOCARPA Nutt. Wild rose.
Infrequent in woods.

ROSA NUTKANA Presl. Wild rose.
Common in open places, Bellingham; Nooksack valley.

ROSA PISOCARPA Gray. Bunched rose.
Not uncommon.

AGRIMONIA GRYPSOSEPALA Wallr.
Frequent in low ground and along ditches.

POTENTILLA MONSPELIENSIS L. Five finger,
Not uncommon in low ground.

FRAGARIA BRACTEATA Heller. Wild strawberry.
Locally abundant on the uplands.

An undetermined Fragaria is abundant in patches in open places.

ARGENTINA ANSERINA (L.) Rydb. Silver weed.
Common in wet and saline soil.

COMARUM PALUSTRE L. Purple marsh locks.
Along margins of streams and lakes.

GEUM MACROPHYLLUM Willd. Avens.
Common in shady places.

MALACEAE

AMELANCHIER FLORIDA Lindl. Service berry.
Infrequent in open woods.

CRATAEGUS Douglasii Lindl. Thorn apple.
Common on Lummi point, otherwise rare.

PYRUS RIVULARIS Dougl. Wild crab apple.
Common in lowland thickets.

PYRUS SITCHENSIS (Roem.) Piper. Mountain ash.
Infrequent in the woods.

PYRUS OCCIDENTALIS Wats. Mountain ash.
Common near timber line on the higher mountains.

AMYGDALACEAE

PRUNUS EMARGINATA Dougl. Wild cherry.
Not uncommon in the woods.

OSMARONIA CERASIFORMIS (T. & G.) Greene. Indian plum.
Infrequent along streams.

FABACEAE

LUPINUS POLYPHYLLUS Lindl. Lupine.
Low ground at Bellingham.

LUPINUS RIVULARIS Dougl. Lupine.
Dry, open places in the foothills.

LUPINUS LYALLII Gray. Lupine.
On Mt. Baker above the timber line.

TRIFOLIUM DUBIUM Sibth. Yellow clover.
Infrequent in waste places.

TRIFOLIUM VARIEGATUM Nutt.
Common in sandy soil at Lummi point.

TRIFOLIUM REPENS L. White clover.
Common, introduced.

TRIFOLIUM PRATENSE L. Red clover.
Common, escaped from cultivation.

TRIFOLIUM HYBRIDUM L. Alsike clover.
Common, escaped from cultivation.

TRIFOLIUM PROCUMBENS L. Yellow clover.
Uncommon near Lynden.

Trifolium flavulnm Greene, *T. microdon* H. & A., *T. albo-purpureum* T. & G., and *T. gracilentum* T. & G. were collected at "Whatcom" by Suksdorf.

MEDICAGO LUPULINA L. Yellow trefoil.
Sparingly introduced near Bellingham.

MEDICAGO DENTICULATA Willd. Bur clover.
Rare near Bellingham.

MEDICAGO SATIVA L. Alfalfa.
Found in vacant lots at Bellingham.

HOSACKIA DENTICULATA Drew
Dry soil, South Bellingham; Lummi point.

VICIA CRACCA L. Vetch.
Infrequent, South Bellingham.

VICIA AMERICANA Muhl.
Infrequent along edges of woods.

VICIA GIGANTEA Hook. Vetch.
Common along the shore, South Bellingham.

LATHYRUS MARITIMUS (L.) Bigel. Pea.
Common along the sea shore.

CYTISUS SCOPARIUS Link. Scotch broom.

Waste places in Bellingham; south of Blaine along the railroad track, *Annie L. Fallis.*

GERANIACEAE

GERANIUM PUSILLUM Burm. Geranium.

A common weed in barnyards.

GERANIUM MOLLE L.

Dry ground, South Bellingham.

ERODIUM CICUTARIUM (L.) L'Her. Alfilaria.

Along railroad track in Bellingham.

CELASTRACEAE

PACHYSTIMA MYRSINITES (Pursh) Raf.

Infrequent in the foothills.

ACERACEAE

ACER MACROPHYLLUM Pursh. Maple.

Common in the woods.

ACER CIRCINATUM Pursh. Vine maple.

Common in the upland forests.

ACER DOUGLASII Hook. Douglas maple.

Infrequent, Marietta in the foothills.

IMPATIENTIACEAE

IMPATIENS NOLITANGERE L. Jewel weed.

Deming, *Flett;* North Fork of Nooksack river, *Suksdorf.*

RHAMNACEAE

RHAMNUS PURSHIANA DC. Cascara sagrada.

Common in the woods.

MALVACEAE

MALVA ROTUNDIFOLIA L. Mallow.

Rare in barnyards.

SIDALCEA HENDERSONI Wats.

Near Chuckanut bay.

HYPERICACEAE

HYPERICUM PERFORATUM L. St. John's wort.

Found only on Muenscher's farm at Ten Mile.

HYPERICUM ANAGALLOIDES C. & S.

Common in wet, boggy places.

VIOLACEAE

VIOLA GLABELLA Nutt. Yellow violet.
Infrequent in the woods; common in foothills.

VIOLA ORBICULATA Geyer. Yellow violet.
Common in the mountains, Baker lake.

VIOLA MACLOSKEYI Lloyd.
Very common in wet soil.

VIOLA HOWELLII Gray. Blue violet.
Not uncommon.

VIOLA ADUNCA Smith. Blue violet.
Common in low ground.

ELEAGNACEAE

SHEPHERDIA CANADENSIS Nutt. Buffalo berry.
Rare along the shore near Chuckanut bay.

ONAGRACEAE

CIRCAEA PACIFICA Asch. & Magnus. Enchanter's nightshade.
Common in moist, shady woods.

EPILOBIUM ANGUSTIFOLIUM L. Fire weed.
Common on burned over areas.

EPILOBIUM PANICULATUM Nutt.
Infrequent, Ten Mile.

EPILOBIUM ADENOCAULON Haussk. Fire weed.
Very abundant on burned over, low ground.

EPILOBIUM LUTEUM Pursh. Yellow flowered fire weed.
Springy places near the summit of Lookout mountain.

OENOTHERA BIENNIS MURICATA (L.) Lindl. Evening primrose.
Uncommon between Sumas and Clearbrook.

BOISDUVALIA DENSIFLORA Lindl.
Along Hannegan road; quite abundant.

ARALIACEAE

ECHINOPANAX HORRIDUM (Smith) Dec. & Planch. Devil's club.
Frequent in rich, upland forests.

APIACEAE

SANICULA MENZIESII H. & A. Sanicule.
Uncommon, Lummi point; Chuckanut bay.

DAUCUS PUSILLUS Michx. Wild carrot.
Infrequent along roads, Northwood; Bellingham.

WASHINGTONIA BREVIPES C. & R. Sweet cicely.
Common in the woods.

WASHINGTONIA DIVARICATA Britton.
Infrequent in the foothills.

HERACLEUM LANATUM Michx. Cow parsnip.
Infrequent in lowlands, Nooksack river valley.

LOMATIUM NUDICAULE (Pursh) C. & R.
Dry, rocky soil along the seashore.

CICUTA VAGANS Greene. Water hemlock.
Common in moist ground.

OENANTHE SARMENTOSA Presl. Water celery.
Very abundant in wet ground; poisonous to cattle.

SIUM CICUTAEFOLIUM Schrank. Water parsnip.
Infrequent along the shore of Lake Padden.

CORNACEAE

CORNUS NUTTALLII Audubon. Flowering dogwood.
Infrequent in the open woods.

CORNUS CANADENSIS L. Bunchberry.
Common in the hills, otherwise uncommon.

CORNUS OCCIDENTALIS (T. & G.) Coville. Western dogwood.
Common along streams.

PYROLACEAE

MONESES UNIFLORA Gray
Coniferous woods near Baker lake, rare.

CHIMAPHILA UMBELLATA (L.) Nutt.
Uncommon in coniferous forests.

CHIMAPHILA MENZIESII (R. Br.) Spreng.
Uncommon near Baker lake.

PYROLA INCARNATA (DC.) Fisch. Wintergreen.
Wet woods, Silver lake; Green lake.

PYROLA SECUNDA L.
Common in the mountains.

PYROLA PICTA Smith

Infrequent in the mountains.

PYROLA BRACTEATA Hook.

Infrequent in the upland forests.

MONOTROPACEAE

MONOTROPA UNIFLORA L. Indian pipe.

Very rare in deep coniferous woods, Ten Mile.

HYPOPITYS HYPOPITYS (L.) Small

Deep coniferous woods along Baker river, rare.

PTEROSPORA ANDROMEDEA Nutt. Pine drops.

Very rare in coniferous woods of the foothills.

ERICACEAE

ARBUTUS MENZIESII Pursh. Madrona.

On the bluffs along Puget Sound, Lummi island.

ARCTOSTAPHYLOS TOMENTOSA (Pursh) Dougl. Manzanita.

Rocky cliffs near the summit of Lookout mountain.

ARCTOSTAPHYLOS UVI-URSI (L.) Spreng. Kinnikinnick.

Uncommon, Mt. Baker.

CASSIOPE MERTENSIANA (Bong.) G. Don. Moss heather.

Near timber line of Mt. Baker.

PHYLLODOCE EMPETRIFORMIS (Smith) D. Don. Red heather.

Common near the timber line of Mt. Baker.

KALMIA GLAUCA Ait. Swamp laurel.

In peat bogs uear North Prairie. Fountain lake.

RHODODENDRON ALBIFLORUM Hook. Azalea.

In the alpine forests of the higher mountains.

MENZIESIA FERRUGINEA Smith. Fool's huckleberry.

Common in woods in peat ground.

LEDUM GROENLANDICUM Oeder. Labrador tea.

Very common in peat bogs.

GAULTHERIA SHALLON Pursh. Salal.

Common in upland forests about Bellingham.

GAULTHERIA OVATIFOLIA Gray

In the mountains south of Baker lake.

VACCINIACEAE

VACCINIUM PARVIFLORUM Smith. Red huckleberry.
Common in the upland woods.

VACCINIUM OVATUM Pursh. Blue huckleberry.
Infrequent in the woods.

VACCINIUM OVALIFOLIUM Smith. Blue huckleberry.
Infrequent in the mountains

VACCINIUM SCOPARIUM Leiberg. Blueberry.
Above the timber line on Mt. Baker.

OXYCOCCUS OXYCOCCUS INTERMEDIUS (Gray) Piper. Western cranberry.
Locally abundant in peat bogs, Fountain lake; Silver lake.

PRIMULACEAE

GLAUX MARITIMA L. Black saltwort.
Along the seashore, South Bellingham.

TRIENTALIS LATIFOLIA Hook. Star flower.
Common in open woods.

TRIENTALIS ARCTICA Fisch. Marsh star flower.
Peat marsh along Silver lake.

NAUMBURGIA THYRSIFLORA (L.) Duby
Infrequent along Green lake.

GENTIANACEAE

GENTIANA ACUTA Michx. Gentian.
Infrequent in shady places.

MENYANTHACEAE

MENYANTHES TRIFOLIATA L. Buckbean.
Common in swamps.

POLEMONIACEAE

GILIA CAPITATA Hook. Gilia.
Infrequent in dry ponds.

GILIA ACHILLEAEFOLIA Benth.
Whatcom county, *Suksdorf.*

GILIA BICOLOR (Nutt.) Piper
Infrequent, South Bellingham.

NAVARRETIA SQUARROSA (Esch.) H. & A. Skunk weed.
Common along roadsides, Ten Mile.

HYDROPHYLLACEAE

ROMANZOFFIA SITCHENSIS Bong.

Mt. Baker, *Flett 836*.

BORAGINACEAE

AMSINCKIA INTERMEDIA F. & M. Fiddle neck.

An uncommoa weed, Ten Mile.

AMSINCKIA LYCOPSOIDES Lehm.

Infrequent about Bellingham.

PLAGIOBOTHRYS TENELLUS (Nutt.) Gray

Not infrequent in dry ground.

CRYPTANTHE AFFNIS (Gray) Greene

Uncommon in dry ponds.

MYOSOTIS LAXA Lehm. Forget-me-not.

Infrequent on dry slopes.

MYOSOTIS MACROSPERMA Engelm. White forget-me-not.

Infrequent on dry slopes.

MENTHACEAE

SCUTELLARIA LATERIFLORA L. Skull cap.

Common in low ground.

PRUNELLA VULGARIS L. Heal all.

Very common on the uplands.

MARRUBIUM VULGARE L. Horehound.

Infrequent in yards.

LAMIUM AMPLEXICAULE L. Dead nettle.

Infrequent at Bellingham.

STACHYS CILIATA Dougl. Hedge nettle.

Common along streams in woods.

NEPETA CATARIA L. Catnip.

Introduced, Ten Mile; Deming.

LYCOPUS AMERICANUS Muhl. Water horehound.

Very common in low, wet ground.

MENTHA CANADENSIS L. Mint.

Very abundant in low, wet ground.

MENTHA SPICATA VIRIDIS L. Spearmint.

Escaped from cultivation, Nooksack; Padden lake.

MICROMERIA CHAMISSONIS (Benth.) Greene. Yerba buena.
Dry, open woods, infrequent.

SCROPHULARIACEAE

VERBASCUM THAPSUS L. Mullein.
Common on burned over uplands.

LINARIA LINARIA (L.) Karst. Butter and eggs.
Introduced sparingly, Ferndale.

DIGITALIS PURPUREA L. Foxglove.
Introduced, Nooksack valley below Lynden.

COLLINSIA GRANDIFLORA Dougl. Blue lips.
Introduced into fields, uncommon.

PENTSTEMON DIFFUSUS Dougl. Wild foxglove.
Rocky banks along Baker River.

VERONICA ARVENSIS L. Speedwell.
Common in fields.

VERONICA SERPYLLIFOLIA HUMIFUSA (Dickson) Hook.
Common in woods.

VERONICA AMERICANA Schwein.
Common in ditches and pools.

VERONICA SCUTELLATA L.
Infrequent along edges of ponds and lakes.

MIMULUS LANGSDORFII Donn. Monkey flower.
Very common in ditches and wet soil.

MIMULUS FLORIBUNDUS Dougl.
Infrequent in low ground.

MIMULUS LEWISII Pursh. Red monkey flower.
Common in "the meadows" of Mt. Baker.

PEDICULARIS RACEMOSA Dougl. Lousewort.
Rare on Mt. Baker.

PEDICULARIS BRACTEOSA Benth.
Rare in moist, shady places in the mountains.

CASTILLEJA ANGUSTIFOLIA BRADBURII (Nutt.) Fernald.
Indian paint brush
Along Birch bay; Lummi point; Nooksack mountain.

CASTILLEJA MINIATA Dougl.

South of Bellingham.

CASTILLEJA OREOPOLA Greenm.

Above the timber line of Mt. Baker.

ORTHOCARPUS ATTENUATUS Gray

Uncommon near Custer.

SOLANACEAE

SOLANUM DULCAMARA L. Bittersweet.

Introduced along water, Ten Mile.

SOLANUM NIGRUM L.

Rare in sandy soil, Birch bay.

PLANTAGINACEAE

PLANTAGO MAJOR L. Plantain.

A common weed.

PLANTAGO LANCEOLATA L. Rib grass.

A common weed in clover fields.

PLANTAGO MARITIMA L. Seaside plantain.

Along seashores just above high tide, Bellingham bay.

OROBANCHACEAE

OROBANCHE COMOSA Hook.

On dry, rocky hills near Chuckanut bay.

RUBIACEAE

GALIUM BOREALE L. Bed straw.

Very common.

GALIUM APARINE L. Cleavers.

Infrequent.

CAPRIFOLIACEAE

LINNAEA AMERICANA Forbes. Twin flower.

Very common in forests of foothills, otherwise uncommon.

SYMPHORICARPOS RACEMOSUS Michx. Snowberry.

Common in open places of woods.

LONICERA CILIOSA Pursh. Climbing honeysuckle.

Infrequent in upland forests.

LONICERA HISPIDULA Dougl. Pink honeysuckle.

Uncommon, Lummi point; Lummi island.

LONICERA INVOLUCRATA Banks. Black twinberry.
Common in peat ground.

SAMBUCUS GLAUCA Nutt. Blue elder.
Common in Nooksack valley.

SAMBUCUS CALLICARPA Greene. Red elder.
Very common and widely distributed.

VIBURNUM PAUCIFLORUM Pylaie. High bush cranberry.
Rare along streams, Ten Mile.

VALERIANACEAE

VALERIANA SITCHENSIS Bong. Valerian.
Very common, Mt. Baker, Nooksack and Lookout mountains.

VALERIANELLA CONGESTA Lindl.
Infrequent in the foothills.

CUCURBITACEAE

MICRAMPELIS OREGANA (T. & G.) Greene
Sparingly introduced near Weiser lake.

CAMPANULACEAE

CAMPANULA ROTUNDIFOLIA L. Bellflower.
Infrequent on dry, open mountains.

RAPUNTIUM DORTMANNA (L.) Presl. Lobelia.
Whatcom county, *Suksdorf 983*.

CICHORIACEAE

LAPSANA COMMUNIS L.
Infrequent in Bellingham.

CICHORIUM INTYBUS L. Chicory.
Escaped from cultivation, Nooksack valley near Lynden.

HYPOCHAERIS RADICATA L. Gosmore.
A troublesome weed, which is spreading rapidly.

TARAXACUM TARAXACUM (L.) Karst. Dandelion.
Very common everywhere.

TARAXACUM ERYTHROSPERMUM Andrz. Red seeded dandelion.
Sparingly introduced.

HIERACIUM ALBIFLORUM Hook. Hawkweed.
Common in the woods.

LACTUCA SPICATA (Lam.) A. S. Hitchcock.
Infrequent in woods and swamps.

LACTUCA SCARIOLA INTEGRATA Gren. & Godr. Prickly lettuce.
In fields and along roads near Bellingham.

SONCHUS ASPER (L.) Hill. Sow thistle.
A common field weed.

AMBROSIACEAE

CAERTNERIA BIPINNATIFIDA (Nutt.) Kuntze. Sand bur.
Along the seashore, Birch bay; Chuckanut bay.

ASTERACEAE

GRINDELIA INTEGRIFOLIA DC.
Near Chuckanut bay.

GRINDELIA OREGANA Gray
Infrequent at Birch bay.

SOLIDAGO ELONGATA Nutt. Golden rod.
Common.

ERIGERON PHILADELPHICUS L.
Rare except along Baker river valley.

ERIGERON CANADENSIS L. Fleabane.
An uncommon weed.

An unidentified *Erigeron* was collected on Mt. Baker.

ASTER FREMONTII T. & G. Aster.
Infrequent on the uplands.

ASTER FOLIACEUS FRONDEUS Gray. Aster.
Common on Mt. Baker.

An undetermined *Aster* is infrequent in the lowlands, and another is common on Mt. Baker.

MADIA EXIGUA (Smith) Greene
Infrequent, South Bellingham.

MADIA RACEMOSA (Nutt.) Torr.
Common along roads, Guide Meridian.

MADIA MADIOIDES (Nutt.) Piper
Infrequent along Bellingham bay.

MADIA GLOMERATA Hook. Tarweed.
Along roadside between Bellingham and Wahl.

BIDENS CERNUA L.

Common in wet ground.

ERIOPHYLLUM LANATUM (Pursh) Forbes

Abundant on dry, rocky soil along Chuckanut bay.

ACHILLEA MILLEFOLIUM LANULOSA (Nutt.) Piper. Yarrow.

Very common.

ANTHEMIS COTULA L. Mayweed.

Very common in old pig pens.

MATRICARIA MATRICARIOIDES (Less.) Porter

Common along roadsides.

CHRYSANTHEMUM LEUCANTHEMUM SUBPINNATIFIDUM Fernald. Oxeye daisy.

Common in meadows near Ten Mile.

CHRYSANTHEMUM PARTHENIUM (L.) Pers. Feverfew.

Escaped from gardens, Lynden.

TANACETUM HURONENSE Nutt. Tansy.

Escaped from gardens.

ARTEMISIA LUDOVICIANA Nutt. White sage.

Introduced near Lynden and at Bellingham.

ARTEMISIA SUKSDORFII Piper

Along Chuckanut bay; rare north of Lynden.

ARNICA LATIFOLIA Bong. Arnica.

Near the timber line of Mt. Baker in ravines.

SENECIO VULGARIS L.

A common weed.

SENECIO PAUCIFLORUS Pursh

Burned over uplands, Ten mile.

SENECIO PAUCIFLORUS FALLAX Greenm.

Roadside in partial shade, Deming, *Flett 852*.

SENECIO TRIANGULARIS Hook.

Open places on Lookout mountain and Mt. Baker.

ANAPHALIS MARGARITACEA OCCIDENTALIS Greene. Everlasting.

Common in burned over areas.

GNAPHALIUM ULIGINOSUM L.

Common in dried up waste places.

ADENOCAULON BICOLOR Hook.
Common in the upland forests.

PSILOCARPUS TENELLUS Nutt.
Infrequent near Chuckanut bay.

CENTAUREA CYANUS L. Cornflower.
Escaped from gardens.

CARDUUS ARVENSIS (L.) Robs. Canada thistle.
A common and rapidly spreading weed.

CARDUUS LANCEOLATUS L. Bull thistle.
Very common everywhere.

CARDUUS EDULIS (Nutt.) Greene. Tall thistle.
Infrequent in burned over areas.

ARCTIUM MINUS Schk. Burdock.
Common in vacant lots and along roadsides.

Lynden, Washington, September, 1914.

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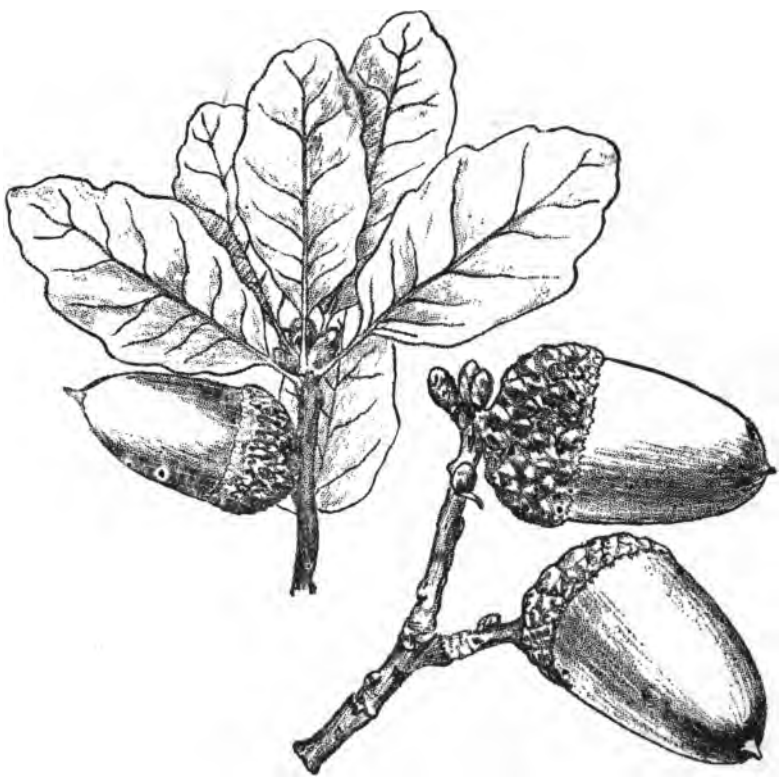

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Volume 9 February 15, 1915

MUHLENBERGIA

THE WHITEWATER SANDS

By S. B. Parish

That part of southern California which drains towards the Pacific ocean, commonly called the Cismontane Region, is separated from the Colorado desert by a lofty range of mountains, through which the San Gorgonio pass affords a wide and easy opening. The summit of the pass is but 2558 feet above sea level, while on the one hand the twin peaks San Gorgonio and San Bernardino each exceeds 12000 feet, and on the other, San Jacinto, 10000 feet in altitude. Beyond, the hot desert slopes rapidly between the long ranges of scorched mountains which border it on either side to the Salton sink, whose greatest depth is 275 feet below the level of the sea. The principal drainage of the desert slope of San Gorgonio is carried by the Whitewater, a considerable stream, as streams are reckoned in this dry country, and smaller streams descend from San Jacinto. When filled by the floods of winter they all bring down heavy loads of sand, which is deposited across the throat of the pass, while the water speedily disappears in the thirsty ground.

Here, it is evident, are conditions for the production of a sand desert. The heated air, rising from the burning depression of the sink, causes a strong draught of wind to flow down the pass, and as it goes it picks up the sand deposited across its course by the streams, which it carries along, until it gradually drops its load, as its velocity is moderated by the increasing width of the desert. So great is the force of these sand blasts that, at times, it is difficult, and even impossible, to face them, and the railway tracks are so obstructed by drifts that trains are

Plate 12. A Larrea prostrate and modified in form by the wind. From a photograph by Mr. C. F. Saunders